Second Revision No. 8347-NFPA 70-2021 [Global Comment]

Please see attached Word file for CMP-6 changes to Definitions in Article 100 for style manual compliance and correlation issues.

Supplemental Information

File Name	Description	Approved
NEC_CMP6_100_SR8347.docx	For staff use	
NEC_CMP6_100_SR8347_for_ballot.docx	For ballot	

Submitter Information Verification

Committee: NEC-P06
Submittal Date: Mon Oct 25 18:03:12 EDT 2021

Committee Statement

Committee Statement: Modifications were made on multiple definitions at the request of the Correlating Committee and to comply with the NEC Style Manual.
Response Message: SR-8347-NFPA 70-2021

Public Comment No. 793-NFPA 70-2021 [Global Input]

Conductor, Bare. (Bare Conductor)~~.~~ A conductor having no covering or electrical insulation whatsoever. (CMP-6)

Conductor, Covered. (Covered Conductor)~~.~~ A conductor encased within material of composition or thickness that is not recognized by this Code as electrical insulation. (CMP-6)

Conductor, Insulated. (Insulated Conductor)~~.~~ A conductor encased within material of composition and thickness that is recognized by this Code as electrical insulation. (CMP-6)

Conductor, Copper-Clad Aluminum. (**Copper-Clad Aluminum Conductor**)~~s.~~ Conductor~~s~~ drawn from a copper-clad aluminum rod, with the copper metallurgically bonded to an aluminum core. (CMP-6)

~~Messenger or~~ **Messenger Wire** (Messenger)**.** A wire that is run along with or integral with a cable or conductor to provide mechanical support for the cable or conductor. (CMP-6) ~~Messenger or Messenger Wire. A wire that is run along with or integral with a cable or conductor to provide mechanical support for the cable or conductor. (CMP-6)~~

Cable, Power and Control Tray, **Type TC**. (**Power and Control Tray Cable**) A factory assembly of two or more insulated conductors, with or without associated bare or covered equipment grounding conductors, under a nonmetallic jacket. (CMP-6)

Second Revision No. 8426-NFPA 70-2021 [Detail]

310.10(G)(4) Ampacity Correction or Adjustment.

Conductors installed in parallel shall comply with ~~the~~ 310.15(B) and ~~or~~ 310.15(C).

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Tue Oct 26 14:56:24 EDT 2021

Committee Statement

Committee Statement: An editorial change has been made to ensure that when installing conductors in parallel that both adjustment factors and temperature corrections are applied and not one or the other.

Response Message: SR-8426-NFPA 70-2021

Public Comment No. 1323-NFPA 70-2021 [Section No. 310.10(G)(4)]

Second Revision No. 8432-NFPA 70-2021 [Detail]

See attached Word file for revisions to Table 310.16 and Table 310.17.

Supplemental Information

File Name	Description	Approved
NEC_CMP6_310.21_SR8432.docx	For staff use	
NEC_CMP6_310.21_SR8432_for_ballot.docx	For ballot	

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Tue Oct 26 15:15:35 EDT 2021

Committee Statement

Committee Statement: The panel acted to revert to 2020 code language for the minimum size of conductors for 310.3(A), Tables 310.16 and 310.17, and wiring methods in multiple articles, including Articles 320, 330, 334, 336, and 340. To ensure public safety, further time is needed to study 14 AWG copper-clad aluminum and 16 AWG copper as minimum conductor sizes.

All of the public comments submitted on this topic were considered by the panel. Multiple test reports were presented to the panel as substantiation for the public comments in the 2023 revision cycle covering 14 AWG copper-clad aluminum conductor heating at certain ampacity levels under insulation to replicate a real-world installation. The reports point to the need for a deeper understanding of the performance of 14 AWG copper-clad aluminum.

During the 2023 NEC revision cycle, the panel received reports and presentations from:

1) the Bimetallics Task Group (conducted at an Eaton facility)

2) the Copper Development Association (conducted at a Hampton Tedder facility)

3) the Southwire company (conducted at the DB Cofer laboratory)

4) the Cable Technologies Laboratory (conducted at their facility)

5) the Cerrowire company (conducted at the Marmon Innovation and Technology Center)

The Panel also considered reports from the 2020 NEC revision cycle, including the NSF International report.

After considering all the information and results presented in the reports, public inputs, and public comments, concerns were recognized about conductor overheating in common, everyday installations that need to be addressed prior to reducing the allowable branch circuit conductor size. Primarily, the evidence of excessive heat rise that occurs when wiring methods are installed in thermal insulation needs to be addressed. Voltage drop was also identified as a concern and needs to be addressed.

To determine the appropriate code requirements to ensure the installation of reduced branch circuit conductor sizes is both practical and safe, additional information is required. The panel requests public input that includes the following information obtained from credible sources and qualified testing laboratories:

1) Testing of representative wiring methods with 14 AWG copper-clad aluminum and 16 AWG copper shall be performed. Representative wiring methods could include those with non-metallic jackets, metallic sheaths, and those in metallic and non-metallic raceway systems.

2) Each wiring method shall have three current-carrying conductors.

3) At a minimum, testing of 16 AWG copper and 14 AWG copper-clad aluminum in thermal insulation is required. To address questions that were raised about existing branch circuit conductor sizes and heat rise in thermal insulation, the panel is also requesting testing of:

a. 14 AWG copper and 12 AWG copper-clad aluminum

b. 12 AWG copper and 10 AWG copper-clad aluminum

4) Equivalent testing of aluminum conductors is also welcomed.

5) For each wiring method, testing shall be performed at the 60C, 75C, and 90C ampacity values as appropriate as indicated or proposed in Table 310.16. Each test shall continue for a minimum of 3 hours or until thermal stability is reached, unless the temperature exceeds 150C at which point the test will be terminated. Conductor temperature shall be no more than 2C above ambient when each test begins.

6) At a minimum, testing shall include one continuous 100-foot length of wiring between the supply and load connections. Thermal insulation R-values and types shall comply with International Residential Code (IRC) Table N1102.1.3 minimum values for climate zone 5. A minimum of 90% of the wiring method shall be placed inside the thermal insulation. Testing that provides comparisons of differing thermal insulation types and R-values is encouraged.

7) Testing shall include installations that are representative of both attic and wall locations.

8) Thermocouples shall be affixed in contact with the insulation of a current-carrying conductor inside the wiring method. For cable wiring methods the jacket or sheath shall be replaced/restored over the thermocouple.

9) Thermocouples shall not be placed on or next to framing members or any other building components other than thermal insulation and the conductor insulation. Thermocouples shall be placed no less than every 10 feet along the wire within the wiring method and temperature data values shall be recorded no less than every 30 seconds. Thermocouples shall be placed on the conductor insulation within one foot of the supply and load connections. Ambient temperature shall be recorded continuously.

10) Voltage and current at the supply and load connections shall be monitored and values shall be recorded at a minimum of every 30 seconds.

11) All conductors shall be tested under equivalent conditions.

The panel has also identified remediating actions that could be taken to prevent overheating in this type of installation, including installation restrictions, reduced ampacity values in the Article 310 tables, or ampacity adjustment requirements.

Response Message: SR-8432-NFPA 70-2021

Public Comment No. 1849-NFPA 70-2021 [Section No. 310.21]

Public Comment No. 1448-NFPA 70-2021 [Section No. 310.21]

Public Comment No. 2162-NFPA 70-2021 [Section No. 310.21]

Public Comment No. 1447-NFPA 70-2021 [Section No. 310.21]

310.21 Ampacities of Bare or Covered Conductors in Free Air.

The ampacities shall be as specified in Table 310.21 where all of the following conditions apply:

(1) Wind velocity is 610 mm/sec (2 ft/sec).

(2) Conductors are 80°C (176°F) total conductor temperature.

(3) Wiring is installed in a 40°C (104°F) ambient temperature.

Table 310.16 Ampacities of Insulated Conductors with Not More Than Three Current-Carrying Conductors in Raceway, Cable, or Earth (Directly Buried)

Size AWG or kcmil	Temperature Rating of Conductor [See Table 310.4(1)]						Size AWG or kcmil
	60°C (140°F)	75°C (167°F)	90°C (194°F)	60°C (140°F)	75°C (167°F)	90°C (194°F)	
	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, XHWN, USE, ZW	Types TBS, SA, SIS, FEP, FEPB, MI, PFA, RHH, RHW-2, THHN, THHW, THW-2, THWN-2, USE-2, XHH, XHHW, XHHW-2, XHWN, XHWN-2, XHHN, Z, ZW-2	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, XHWN, USE	Types TBS, SA, SIS, THHN, THHW, THW-2, THWN-2, RHH, RHW-2, USE-2, XHH, XHHW, XHHW-2, XHWN, XHWN-2, XHHN	
	COPPER			ALUMINUM OR COPPER-CLAD ALUMINUM			
18*	—	—	14	—	—	—	—
16*	~~10~~	~~15~~	~~20~~18	—	—	—	—
14*	15	20	25	~~10~~‡	~~15~~‡	~~20~~‡	~~14*~~
12*	20	25	30	15	20	25	12*
10*	30	35	40	25	30	35	10*
8	40	50	55	35	40	45	8
6	55	65	75	40	50	55	6
4	70	85	95	55	65	75	4
3	85	100	115	65	75	85	3
2	95	115	130	75	90	100	2
1	110	130	145	85	100	115	1
1/0	125	150	170	100	120	135	1/0
2/0	145	175	195	115	135	150	2/0
3/0	165	200	225	130	155	175	3/0
4/0	195	230	260	150	180	205	4/0
250	215	255	290	170	205	230	250
300	240	285	320	195	230	260	300
350	260	310	350	210	250	280	350
400	280	335	380	225	270	305	400
500	320	380	430	260	310	350	500

Size AWG or kcmil	Temperature Rating of Conductor [See Table 310.4(1)]						Size AWG or kcmil
	60°C (140°F)	75°C (167°F)	90°C (194°F)	60°C (140°F)	75°C (167°F)	90°C (194°F)	
	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, XHWN, USE, ZW	Types TBS, SA, SIS, FEP, FEPB, MI, PFA, RHH, RHW-2, THHN, THHW, THW-2, THWN-2, USE-2, XHH, XHHW, XHHW-2, XHWN, XHWN-2, XHHN, Z, ZW-2	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, XHWN, USE	Types TBS, SA, SIS, THHN, THHW, THW-2, THWN-2, RHH, RHW-2, USE-2, XHH, XHHW, XHHW-2, XHWN, XHWN-2, XHHN	
	COPPER			ALUMINUM OR COPPER-CLAD ALUMINUM			
600	350	420	475	285	340	385	600
700	385	460	520	315	375	425	700
750	400	475	535	320	385	435	750
800	410	490	555	330	395	445	800
900	435	520	585	355	425	480	900
1000	455	545	615	375	445	500	1000
1250	495	590	665	405	485	545	1250
1500	525	625	705	435	520	585	1500
1750	545	650	735	455	545	615	1750
2000	555	665	750	470	560	630	2000

Notes:

1. Section 310.15(B) shall be referenced for ampacity correction factors where the ambient temperature is other than 30°C (86°F).

2. Section 310.15(C)(1) shall be referenced for more than three current-carrying conductors.

3. Section 310.16 shall be referenced for conditions of use.

*Section 240.4(D) shall be referenced for conductor overcurrent protection limitations, except as modified elsewhere in the *Code*.

†~~Applicable only to copper-clad aluminum conductors.~~

Table 310.17 Ampacities of Single-Insulated Conductors in Free Air

Size AWG or kcmil	Temperature Rating of Conductor [See Table 310.4(1)]						Size AWG or kcmil
	60°C (140°F)	75°C (167°F)	90°C (194°F)	60°C (140°F)	75°C (167°F)	90°C (194°F)	
	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, XHWN, ZW	Types TBS, SA, SIS, FEP, FEPB, MI, PFA, RHH, RHW-2, THHN, THHW, THW-2, THWN-2, USE-2, XHH, XHHW, XHHW-2, XHWN, XHWN-2, XHHN, Z, ZW-2	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, XHWN	Types TBS, SA, SIS, THHN, THHW, THW-2, THWN-2, RHH, RHW-2, USE-2, XHH, XHHW, XHHW-2, XHWN, XHWN-2, XHHN	
	COPPER			ALUMINUM OR COPPER-CLAD ALUMINUM			
18	—	—	18	—	—	—	—
16	~~20~~	~~25~~	~~30~~24	—	—	—	—
14*	25	30	35	~~20~~†	~~25~~†	~~30~~†	~~14*~~
12*	30	35	40	25	30	35	12*
10*	40	50	55	35	40	45	10*
8	60	70	80	45	55	60	8
6	80	95	105	60	75	85	6
4	105	125	140	80	100	115	4
3	120	145	165	95	115	130	3
2	140	170	190	110	135	150	2
1	165	195	220	130	155	175	1
1/0	195	230	260	150	180	205	1/0
2/0	225	265	300	175	210	235	2/0
3/0	260	310	350	200	240	270	3/0
4/0	300	360	405	235	280	315	4/0
250	340	405	455	265	315	355	250
300	375	445	500	290	350	395	300
350	420	505	570	330	395	445	350
400	455	545	615	355	425	480	400
500	515	620	700	405	485	545	500
600	575	690	780	455	545	615	600
700	630	755	850	500	595	670	700
750	655	785	885	515	620	700	750
800	680	815	920	535	645	725	800
900	730	870	980	580	700	790	900
1000	780	935	1055	625	750	845	1000
1250	890	1065	1200	710	855	965	1250
1500	980	1175	1325	795	950	1070	1500
1750	1070	1280	1445	875	1050	1185	1750
2000	1155	1385	1560	960	1150	1295	2000

Notes:

1. Section 310.15(B) shall be referenced for ampacity correction factors where the ambient temperature is other than 30°C (86°F).

2. Section 310.17 shall be referenced for conditions of use.

*Section 240.4(D) shall be referenced for conductor overcurrent protection limitations, except as modified elsewhere in the *Code*.

‡~~Applicable only to copper-clad aluminum.~~

Second Revision No. 8224-NFPA 70-2021 [Definition: Bottom Shield, Type FCC.]

Bottom Shield~~, Type FCC~~ .

A protective layer that is installed between the floor and ~~Type FCC~~ flat conductor cable (Type FCC) to protect the cable from physical damage and may or may not be incorporated as an integral part of the cable. (324) (CMP-6)

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 25 11:17:21 EDT 2021

Committee Statement

Committee Statement: "Type FCC" removed from the title and relocated into the definition body for ease of searchability by the code user. Definition body reworded for clarity.

Response Message: SR-8224-NFPA 70-2021

Public Comment No. 151-NFPA 70-2021 [Definition: Bottom Shield, Type FCC.]

Second Revision No. 8226-NFPA 70-2021 [Definition: Cable Connector, Type FCC.]

Cable Connector~~, Type FCC~~ .

A connector designed to join flat conductor cables (Type FCC ~~cables~~) without using a junction box. (324) (CMP-6)

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 25 11:19:58 EDT 2021

Committee Statement

Committee Statement: "Type FCC" removed from the title and relocated into the definition body for ease of searchability by the code user. Definition body reworded for clarity.

Response Message: SR-8226-NFPA 70-2021

Public Comment No. 153-NFPA 70-2021 [Definition: Cable Connector, Type FCC.]

Second Revision No. 8234-NFPA 70-2021 [Definition: Cable Joint, Type MV.]

Cable Joint~~, Type MV~~ .

A connection consisting of an insulation system and a connector where two (or more) medium voltage (Type MV) cables are joined together ~~in a way that is to be chemically, mechanically, and electrically stable~~ . (CMP-6)

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 25 11:39:02 EDT 2021

Committee Statement

Committee Statement: Removed "in a way that is to be chemically, mechanically, and electrically stable" as definitions cannot contain requirements. “Type MV” removed from the title and relocated into the definition body for ease of searchability by the code user. The use of "Type MV" clarifies the product application. Definition body reworded for clarity.

Response Message: SR-8234-NFPA 70-2021

Public Comment No. 154-NFPA 70-2021 [Definition: Cable Joint, Type MV.]

Public Comment No. 1705-NFPA 70-2021 [Definition: Cable Joint, Type MV.]

Public Comment No. 1223-NFPA 70-2021 [Definition: Cable Joint, Type MV.]

Second Revision No. 8239-NFPA 70-2021 [Definition: Cable Termination, Type MV.]

Cable Termination~~, Type MV~~ .

A connection consisting of an insulation system and a connector and installed on a medium voltage (Type MV) cable to connect from a cable to a device, such as equipment~~, in a way that is to be chemically, mechanically, and electrically stable~~ . (CMP-6)

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 25 11:54:28 EDT 2021

Committee Statement

Committee Statement: Removed "in a way that is to be chemically, mechanically, and electrically stable" as definitions cannot contain requirements. “Type MV” removed from the title and relocated into the definition body for ease of searchability by the code user. The use of "Type MV" clarifies the product application. Definition body reworded for clarity.

Response Message: SR-8239-NFPA 70-2021

Public Comment No. 1707-NFPA 70-2021 [Definition: Cable Termination, Type MV.]

Public Comment No. 1224-NFPA 70-2021 [Definition: Cable Termination, Type MV.]

Second Revision No. 8716-NFPA 70-2021 [Definition: Cable, Medium Voltage, Type MV.]

Cable, Medium Voltage, Type MV. (Medium Voltage Cable)

A single or multiconductor solid dielectric insulated cable rated 2001 volts up to and including 35,000 volts, nominal. (CMP-6)

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Wed Nov 10 10:15:31 EST 2021

Committee Statement

Committee Statement: This editorial second revision is created by NFPA staff for compliance with 2.2.2.3.1 of the NEC Style Manual regarding inclusion of searchable terms.

Response Message: SR-8716-NFPA 70-2021

Second Revision No. 8251-NFPA 70-2021 [Definition: Cable, Portable Power Feeder. (Portable Power F...]

Cable, Portable Power Feeder. (Portable Power Feeder Cable)

One or more flexible shielded insulated power conductors enclosed in a flexible covering ~~that provides mechanical protection with voltage rating from 2000~~ rated from 2001 to 25,000 volts. (CMP-6)

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 25 12:21:25 EDT 2021

Committee Statement

Committee Statement: Removed "that provides mechanical protection" as definitions cannot contain requirements. Voltage range modified to “2001 to 25,000 volts” to match the voltage range of medium voltage products covered in Article 315. Definition body reworded for clarity.

Response Message: SR-8251-NFPA 70-2021

Public Comment No. 1704-NFPA 70-2021 [New Definition after Definition: Cable, Portable Power Feed...]

Second Revision No. 8254-NFPA 70-2021 [Definition: Compact (as applied to conductor stranding).]

Stranding, Compact. (~~as applied to conductor stranding~~ Compact Stranding).~~

A conductor ~~where~~ stranding method in which each layer of strands is pressed together to minimize the ~~extent that almost all the~~ gaps between the strands ~~are eliminated~~ so ~~that~~ the overall diameter of the finished conductor is less than a concentric stranded conductor and less than a compressed stranded conductor. (CMP-6)

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 25 12:24:35 EDT 2021

Committee Statement

Committee Statement: Modified title with "Stranding, Compact" as requested by the Correlating Committee and added “(Compact Stranding)” for ease of searchability by the code user. Replaced "where" with "in which" as requested by the Correlating Committee. Definition body reworded for clarity.

Response Message: SR-8254-NFPA 70-2021

Public Comment No. 1709-NFPA 70-2021 [Definition: Compact (as applied to conductor stranding).]

Second Revision No. 8255-NFPA 70-2021 [Definition: Compressed (as applied to conductor stranding).]

Stranding, Compressed. (~~as applied to conductor stranding~~ Compressed Stranding).~~

A conductor ~~where~~ stranding method in which the outer layer of strands is pressed together so ~~that~~ the overall diameter of the finished conductor is less than a concentric stranded conductor but greater than a compact stranded conductor. (CMP-6)

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 25 12:29:19 EDT 2021

Committee Statement

Committee Statement: Modified title with "Stranding, Compressed" as requested by the Correlating Committee and added “(Compressed Stranding)” for ease of searchability by the code user. Replaced "where" with "in which" as requested by the Correlating Committee. Definition body reworded for clarity.

Response Message: SR-8255-NFPA 70-2021

Public Comment No. 1711-NFPA 70-2021 [Definition: Compressed (as applied to conductor stranding).]

Second Revision No. 8321-NFPA 70-2021 [Definition: Conductor, Insulated (as applied to messenger-s...]

Conductor, Insulated (as applied to messenger-supported wiring).

Overhead service conductor encased in a polymeric material ~~that has been evaluated~~ adequate for the applied nominal voltage and any conductor types described in 310.4. (396) (CMP-6)

Informational Note: See ICEA S-76-474-2011, *Standard for Neutral Supported Power Cable Assemblies with Weather-Resistant Extruded Insulation Rated 600 Volts*, for ~~evidence of evaluation of~~ information about overhead service conductors.

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 25 16:55:26 EDT 2021

Committee Statement

Committee Statement: Change language in definition from “that has been evaluated” to “adequate for”. to avoid having requirements in definitions and informational notes.

Response Message: SR-8321-NFPA 70-2021

Public Comment No. 810-NFPA 70-2021 [Global Input]

Second Revision No. 8456-NFPA 70-2021 [Definition: Cord Connector.]

Cord Connector.

A ~~female~~ contact device ~~that mates with~~ terminated to a flexible cord that accepts an attachment plug or other ~~male~~ insertion device. (CMP-6)

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Tue Oct 26 16:39:52 EDT 2021

Committee Statement

Committee Statement: The definition was revised for clarity and to reflect the use of this device in general installations. (See Correlating Committee Global PC 1828).

Response Message: SR-8456-NFPA 70-2021

Public Comment No. 1658-NFPA 70-2021 [Definition: Cord Connector.]

Second Revision No. 8242-NFPA 70-2021 [Definition: Cord, Flexible. (Flexible Cord)]

Cord, Flexible. (Flexible Cord)

Two or more flexible insulated conductors enclosed in a flexible covering ~~that provides mechanical protection. [**79:** 3.3.29]~~ . (CMP-6)

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 25 12:01:42 EDT 2021

Committee Statement

Committee Statement: Removed "that provides mechanical protection" as definitions cannot contain requirements. Removed NFPA 79 reference as the revised definition no longer matches the definition in NFPA 79.

Response Message: SR-8242-NFPA 70-2021

Public Comment No. 1714-NFPA 70-2021 [Definition: Cord, Flexible. (Flexible Cord)]

Second Revision No. 8340-NFPA 70-2021 [Definition: Drilling Rig Cable, Type P.]

~~Drilling Rig~~ Cable, ~~Type P.~~ Industrial Mobile, Type IM. (Industrial Mobile Cable)

A factory assembly of one or more insulated flexible tinned copper conductors, with associated equipment grounding conductor(s), with or without a braided metallic armor and with an overall nonmetallic jacket. (CMP-6)

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 25 17:40:18 EDT 2021

Committee Statement

Committee Statement: The title for Type P cable was changed to Type IM in correlation with the changes made in Article 337.

Response Message: SR-8340-NFPA 70-2021

Second Revision No. 8221-NFPA 70-2021 [Definition: Flat Conductor Cable, Type FCC Cable.]

Flat Conductor Cable, Type FCC ~~Cable~~ .

Three or more separate flat copper conductors placed horizontally edge-to-edge and ~~separated and~~ enclosed within an insulating assembly. (324) (CMP-6)

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 25 11:11:08 EDT 2021

Committee Statement

Committee Statement: The use of the word "Type" helps differentiate the specific cable constructions referred to in the definition versus a more general use of terminology such as "service entrance cables" or "nonmetallic-sheathed cables" that might refer to a group of cable types. For wire and cable products, the use of “Type” reinforces the relationship between the NEC and product safety standards. "Cable" is redundant and removed from the end of the title. Definition body reworded for clarity by adding “separate” and “horizontally”. "(324) (CMP-6)" is added at the end of the definition body to match the structure of related definitions.

Response Message: SR-8221-NFPA 70-2021

Public Comment No. 383-NFPA 70-2021 [Definition: Flat Conductor Cable, Type FCC Cable.]

Second Revision No. 8228-NFPA 70-2021 [Definition: Insulating End, Type FCC.]

Insulating End~~, Type FCC~~ .

An insulator designed to electrically insulate the end of a flat conductor cable (Type FCC ~~cable~~) . (324) (CMP-6)

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 25 11:22:33 EDT 2021

Committee Statement

Committee Statement: "Type FCC" removed from the title and relocated into the definition body for ease of searchability by the code user. Definition body reworded for clarity.

Response Message: SR-8228-NFPA 70-2021

Public Comment No. 384-NFPA 70-2021 [Definition: Insulating End, Type FCC.]

Second Revision No. 8229-NFPA 70-2021 [Definition: Metal Shield Connections, Type FCC.]

Metal Shield Connections~~, Type FCC~~ .

Means of connection for flat conductor cables (Type FCC) designed to electrically and mechanically connect a metal shield to another metal shield, to a receptacle housing or self-contained device, or to a transition assembly. (324) (CMP-6)

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 25 11:26:14 EDT 2021

Committee Statement

Committee Statement: "Type FCC" removed from the title and relocated into the definition body for ease of searchability by the code user.

Response Message: SR-8229-NFPA 70-2021

Public Comment No. 387-NFPA 70-2021 [Definition: Metal Shield Connections, Type FCC.]

Second Revision No. 8250-NFPA 70-2021 [Definition: Power-Supply Cord.]

Power-Supply Cord.

~~A length of flexible cord with~~ An assembly consisting of an attachment plug ~~at one end~~ and ~~individual cord conductors not terminated in a cord connector at the opposite end~~ a length of flexible cord connected to utilization equipment . (CMP-6)

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 25 12:17:46 EDT 2021

Committee Statement

Committee Statement: This revised definition more adequately applies to installations under the purview of both CMP 6 and CMP 12 and is intended to replace the two existing definitions.

Response Message: SR-8250-NFPA 70-2021

Public Comment No. 1663-NFPA 70-2021 [Definition: Power-Supply Cord.]

Second Revision No. 8230-NFPA 70-2021 [Definition: Top Shield, Type FCC.]

Top Shield~~, Type FCC~~ .

A grounded metal shield covering under-carpet components of the flat conductor cable (Type FCC) system for the purposes of providing protection against physical damage. (324) (CMP-6)

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 25 11:28:26 EDT 2021

Committee Statement

Committee Statement: "Type FCC" removed from the title and relocated into the definition body for ease of searchability by the code user. Definition body reworded for clarity.

Response Message: SR-8230-NFPA 70-2021

Public Comment No. 391-NFPA 70-2021 [Definition: Top Shield, Type FCC.]

Second Revision No. 8232-NFPA 70-2021 [Definition: Transition Assembly, Type FCC.]

Transition Assembly~~, Type FCC~~ .

An assembly to facilitate connection of the flat conductor cable (Type FCC) system to other wiring systems, incorporating (1) a means of electrical interconnection and (2) a suitable box or covering for providing electrical safety and protection against physical damage. (324) (CMP-6)

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 25 11:31:30 EDT 2021

Committee Statement

Committee Statement: "Type FCC" removed from the title and relocated into the definition body for ease of searchability by the code user. Definition body reworded for clarity.

Response Message: SR-8232-NFPA 70-2021

Public Comment No. 392-NFPA 70-2021 [Definition: Transition Assembly, Type FCC.]

Second Revision No. 8276-NFPA 70-2021 [Section No. 310.1]

310.1 Scope.

This article covers general requirements for conductors rated up to and including 2000 volts and their type designations, insulations, markings, mechanical strengths, ampacity ratings, and uses. These requirements do not apply to conductors that form an integral part of equipment, such as motors, motor controllers, and similar equipment, or to conductors specifically provided for elsewhere in this *Code*.

Informational Note: See Article ~~Chapter~~ 4 400 for flexible cords~~,~~ and flexible cables~~,~~ ~~and~~ . See Article 402 for fixture wires.

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 25 13:58:43 EDT 2021

Committee Statement

Committee Statement: It is most helpful for the Code user to have references to the Articles that cover flexible cords, flexible cables, and fixture wires. This would make it clear that those items have separate requirements and that Section 310 provisions do not apply. In this case, the NEC Style Manual prohibits the most useful references for the Code user, so the FR was an attempt to help the Code user as much as possible and still comply with the NEC Style Manual. The suggested return to referring to Articles would be very helpful for the Code user, so we are requesting that the Correlating Committee use their discretion in permitting this deviation from the NEC Style Manual.

Response Message: SR-8276-NFPA 70-2021

Public Comment No. 778-NFPA 70-2021 [Section No. 310.1]

Second Revision No. 8404-NFPA 70-2021 [Section No. 310.3(A)]

(A) Minimum Size of Conductors.

The minimum size of conductors for voltage ratings up to and including 2000 volts shall be ~~16~~ 14 AWG copper~~, 14~~ or 12 AWG aluminum or copper-clad aluminum, ~~or 12 AWG aluminum,~~ except as permitted elsewhere in this *Code*.

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Tue Oct 26 13:39:44 EDT 2021

Committee Statement

Committee Statement: The panel acted to revert to 2020 code language for the minimum size of conductors for 310.3(A), Tables 310.16 and 310.17, and wiring methods in multiple articles, including Articles 320, 330, 334, 336, and 340. To ensure public safety, further time is needed to study 14 AWG copper-clad aluminum and 16 AWG copper as minimum conductor sizes.

All of the public comments submitted on this topic were considered by the panel. Multiple test reports were presented to the panel as substantiation for the public comments in the 2023 revision cycle covering 14 AWG copper-clad aluminum conductor heating at certain ampacity levels under insulation to replicate a real-world installation. The reports point to the need for a deeper understanding of the performance of 14 AWG copper-clad aluminum.

During the 2023 NEC revision cycle, the panel received reports and presentations from:

1) the Bimetallics Task Group (conducted at an Eaton facility)

2) the Copper Development Association (conducted at a Hampton Tedder facility)

3) the Southwire company (conducted at the DB Cofer laboratory)

4) the Cable Technologies Laboratory (conducted at their facility)

5) the Cerrowire company (conducted at the Marmon Innovation and Technology Center)

The Panel also considered reports from the 2020 NEC revision cycle, including the NSF International report.

After considering all the information and results presented in the reports, public inputs, and public comments, concerns were recognized about conductor overheating in common, everyday installations that need to be addressed prior to reducing the allowable branch circuit conductor size. Primarily, the evidence of excessive heat rise that occurs when wiring methods are installed in thermal insulation needs to be addressed. Voltage drop was also identified as a concern and needs to be addressed.

To determine the appropriate code requirements to ensure the installation of reduced branch circuit conductor sizes is both practical and safe, additional information is required. The panel requests public input that includes the following information obtained from credible sources and qualified testing laboratories:

1) Testing of representative wiring methods with 14 AWG copper-clad aluminum and 16 AWG copper shall be performed. Representative wiring methods could include those with non-metallic jackets, metallic sheaths, and those in metallic and non-metallic raceway systems.

2) Each wiring method shall have three current-carrying conductors.

3) At a minimum, testing of 16 AWG copper and 14 AWG copper-clad aluminum in thermal insulation is required. To address questions that were raised about existing branch circuit conductor sizes and heat rise in thermal insulation, the panel is also requesting testing of:

a. 14 AWG copper and 12 AWG copper-clad aluminum

b. 12 AWG copper and 10 AWG copper-clad aluminum

4) Equivalent testing of aluminum conductors is also welcomed.

5) For each wiring method, testing shall be performed at the 60C, 75C, and 90C ampacity values as appropriate as indicated or proposed in Table 310.16. Each test shall continue for a minimum of 3 hours or until thermal stability is reached, unless the temperature exceeds 150C at which point the test will be terminated. Conductor temperature shall be no more than 2C above ambient when each test begins.

6) At a minimum, testing shall include one continuous 100-foot length of wiring between the supply and load connections. Thermal insulation R-values and types shall comply with International Residential Code (IRC) Table N1102.1.3 minimum values for climate zone 5. A minimum of 90% of the wiring method shall be placed inside the thermal insulation. Testing that provides comparisons of differing thermal insulation types and R-values is encouraged.

7) Testing shall include installations that are representative of both attic and wall locations.

8) Thermocouples shall be affixed in contact with the insulation of a current-carrying conductor inside the wiring method. For cable wiring methods the jacket or sheath shall be replaced/restored over the thermocouple.

9) Thermocouples shall not be placed on or next to framing members or any other building components other than thermal insulation and the conductor insulation. Thermocouples shall be placed no less than every 10 feet along the wire within the wiring method and temperature data values shall be recorded no less than every 30 seconds. Thermocouples shall be placed on the conductor insulation within one foot of the supply and load connections. Ambient temperature shall be recorded continuously.

10) Voltage and current at the supply and load connections shall be monitored and values shall be recorded at a minimum of every 30 seconds.

11) All conductors shall be tested under equivalent conditions.

The panel has also identified remediating actions that could be taken to prevent overheating in this type of installation, including installation restrictions, reduced ampacity values in the Article 310 tables, or ampacity adjustment requirements.

Response Message: SR-8404-NFPA 70-2021

Public Comment No. 2008-NFPA 70-2021 [Section No. 310.3(A)]

Public Comment No. 1937-NFPA 70-2021 [Section No. 310.3(A)]

Public Comment No. 2171-NFPA 70-2021 [Section No. 310.3(A)]

Second Revision No. 8420-NFPA 70-2021 [Section No. 310.10(G)]

(G) Conductors in Parallel.

(1) General.

Aluminum, copper-clad aluminum, or copper circuit conductors for each ungrounded conductor , ~~polarity~~ grounded conductor , or neutral~~, or grounded circuit~~ conductor shall be permitted to be connected in parallel (electrically joined at both ends) only in sizes 1/0 AWG and larger ~~where~~ and shall be installed in accordance with 310.10(G)(2) through (G)(~~6~~ 4).

Exception No. 1: Conductors in sizes smaller than 1/0 AWG shall be permitted to be run in parallel to supply control power to indicating instruments, contactors, relays, solenoids, and similar control devices, or for frequencies of 360 Hz and higher, provided all of the following apply:

(1) They are contained within the same raceway or cable.

(2) The ampacity of each individual conductor is sufficient to carry the entire load current shared by the parallel conductors.

(3) The overcurrent protection is such that the ampacity of each individual conductor will not be exceeded if one or more of the parallel conductors become inadvertently disconnected.

Exception No. 2: Under engineering supervision, 2 AWG and 1 AWG grounded neutral conductors shall be permitted to be installed in parallel for existing installations.

Informational Note: Exception No. 2 can be used to alleviate overheating of neutral conductors in existing installations due to high content of triplen harmonic currents.

(2) Conductor and Installation Characteristics.

The paralleled conductors ~~in~~ that comprise each ~~phase~~ ungrounded conductor , ~~polarity~~ grounded conductor , neutral~~, grounded circuit~~ conductor, equipment grounding conductor, equipment bonding jumper, or supply-side bonding jumper shall comply with all of the following:

(1) Be the same length

(2) Consist of the same conductor material

(3) Be the same size in circular mil area

(4) Have the same insulation type

(5) Be terminated in the same manner

(3) Separate Cables or Raceways.

Where run in separate cables or raceways, the cables or raceways with conductors shall have the same number of conductors and shall have the same electrical characteristics. Conductors ~~of one phase, polarity, neutral, grounded circuit conductor, equipment grounding conductor, or supply-side bonding jumper~~ composing one paralleled set shall not be required to have the same physical characteristics as those of another ~~phase, polarity, neutral, grounded circuit conductor, equipment grounding conductor, or supply-side bonding jumper~~ paralleled set .

Detail SR-8426

(4) Ampacity Correction or Adjustment.

Conductors installed in parallel shall comply with ~~the~~ 310.15(B)~~or~~and~~310.15~~(C).

(5) Equipment Grounding Conductors.

Where parallel equipment grounding conductors are used, they shall be sized in accordance with 250.122. Sectioned equipment grounding conductors smaller than 1/0 AWG shall be permitted in multiconductor cables, if the combined circular mil area of the sectioned equipment grounding conductors in each cable complies with 250.122.

(6) Bonding Jumpers.

Where parallel equipment bonding jumpers or supply-side bonding jumpers are installed in raceways, they shall be sized and installed in accordance with 250.102.

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Tue Oct 26 14:45:52 EDT 2021

Committee Statement

Committee Statement: The language in these sections have been revised to provide clarity and usability when referencing conductors in parallel installations.

Response Message: SR-8420-NFPA 70-2021

Public Comment No. 1814-NFPA 70-2021 [Section No. 310.10(G)(1)]

Public Comment No. 775-NFPA 70-2021 [Section No. 310.10(G)]

Second Revision No. 8429-NFPA 70-2021 [Section No. 310.14(A)(1)]

(1) Tables or Engineering Supervision.

Ampacities for conductors shall be permitted to be determined by tables as provided in 310.15 or under engineering supervision~~,~~ as provided in 310.14(B).

Informational Note No. 1: See 210.19(A), Informational Note No. 4 3 , for voltage drop on branch circuits that this section does not take into consideration. See 215.2(A), Informational Note No. 2, for voltage drop on feeders that this section does not take into consideration.

Informational Note No. 2: See Table 12.5.1 in NFPA 79-2021, *Electrical Standard for Industrial Machinery*, for the allowable ampacities of Type MTW wire.

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Tue Oct 26 14:58:39 EDT 2021

Committee Statement

Committee Statement: A correction was made to the reference for voltage drop in Informational Note No. 1. The reference was to 210.19(A) Informational Note No. 4 and should be Informational Note No. 3.

Response Message: SR-8429-NFPA 70-2021

Public Comment No. 1325-NFPA 70-2021 [Section No. 310.14(A)(1)]

Second Revision No. 8287-NFPA 70-2021 [Section No. 310.21]

Detail SR-8432

310.21 Ampacities of Bare or Covered Conductors in Free Air.

The ampacities shall be as specified in Table 310.21 where all of the following conditions apply:

(1) Wind velocity is 610 mm/sec (2 ft/sec).

(2) Conductors are 80°C (176°F) total conductor temperature.

(3) Wiring is installed in a 40°C (104°F) ambient temperature.

Table 310.16 Ampacities of Insulated Conductors with Not More Than Three Current-Carrying Conductors in Raceway, Cable, or Earth (Directly Buried)

Size AWG or kcmil	Temperature Rating of Conductor [See Table 310.4(1)]						Size AWG or kcmil
	60°C (140°F)	75°C (167°F)	90°C (194°F)	60°C (140°F)	75°C (167°F)	90°C (194°F)	
	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, XHWN, USE, ZW	Types TBS, SA, SIS, FEP, FEPB, MI, PFA, RHH, RHW-2, THHN, THHW, THW-2, THWN-2, USE-2, XHH, XHHW, XHHW-2, ~~XHWN,~~ XHWN-2, XHHN, Z, ZW-2	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, XHWN, USE	Types TBS, SA, SIS, THHN, THHW, THW-2, THWN-2, RHH, RHW-2, USE-2, XHH, XHHW, XHHW-2, ~~XHWN,~~ XHWN-2, XHHN	
	COPPER			ALUMINUM OR COPPER-CLAD ALUMINUM			
18*	—	—	14	—	—	—	—
16*	~~10~~	~~15~~	~~20~~18	—	—	—	—
14*	15	20	25	~~10~~‡	~~15~~‡	~~20~~‡	~~14*~~
12*	20	25	30	15	20	25	12*
10*	30	35	40	25	30	35	10*
8	40	50	55	35	40	45	8
6	55	65	75	40	50	55	6
4	70	85	95	55	65	75	4
3	85	100	115	65	75	85	3
2	95	115	130	75	90	100	2
1	110	130	145	85	100	115	1
1/0	125	150	170	100	120	135	1/0
2/0	145	175	195	115	135	150	2/0
3/0	165	200	225	130	155	175	3/0
4/0	195	230	260	150	180	205	4/0
250	215	255	290	170	205	230	250
300	240	285	320	195	230	260	300
350	260	310	350	210	250	280	350
400	280	335	380	225	270	305	400
500	320	380	430	260	310	350	500
600	350	420	475	285	340	385	600
700	385	460	520	315	375	425	700
750	400	475	535	320	385	435	750

800	410	490	555	330	395	445	800
900	435	520	585	355	425	480	900
1000	455	545	615	375	445	500	1000
1250	495	590	665	405	485	545	1250
1500	525	625	705	435	520	585	1500
1750	545	650	735	455	545	615	1750
2000	555	665	750	470	560	630	2000

Notes:

1. Section 310.15(B) shall be referenced for ampacity correction factors where the ambient temperature is other than 30°C (86°F).

2. Section 310.15(C)(1) shall be referenced for more than three current-carrying conductors.

3. Section 310.16 shall be referenced for conditions of use.

*Section 240.4(D) shall be referenced for conductor overcurrent protection limitations, except as modified elsewhere in the *Code*.

‡ ~~Applicable only to copper-clad aluminum conductors.~~

Table 310.17 Ampacities of Single-Insulated Conductors in Free Air

Size AWG or kcmil	Temperature Rating of Conductor [See Table 310.4(1)]						Size AWG or kcmil
	60°C (140°F)	75°C (167°F)	90°C (194°F)	60°C (140°F)	75°C (167°F)	90°C (194°F)	
	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, XHWN, ZW	Types TBS, SA, SIS, FEP, FEPB, MI, PFA, RHH, RHW-2, THHN, THHW, THW-2, THWN-2, USE-2, XHH, XHHW, XHHW-2, ~~XHWN,~~ XHWN-2, XHHN, Z, ZW-2	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, XHWN	Types TBS, SA, SIS, THHN, THHW, THW-2, THWN-2, RHH, RHW-2, USE-2, XHH, XHHW, XHHW-2, ~~XHWN,~~ XHWN-2, XHHN	
	COPPER			ALUMINUM OR COPPER-CLAD ALUMINUM			
18	—	—	18	—	—	—	—
16	~~20~~	~~25~~	~~30~~24	—	—	—	—
14*	25	30	35	~~20~~‡	—~~25~~‡	~~30~~‡	~~14*~~
12*	30	35	40	25	30	35	12*
10*	40	50	55	35	40	45	10*
8	60	70	80	45	55	60	8
6	80	95	105	60	75	85	6
4	105	125	140	80	100	115	4
3	120	145	165	95	115	130	3
2	140	170	190	110	135	150	2
1	165	195	220	130	155	175	1
1/0	195	230	260	150	180	205	1/0
2/0	225	265	300	175	210	235	2/0
3/0	260	310	350	200	240	270	3/0
4/0	300	360	405	235	280	315	4/0

250	340	405	455	265	315	355	250
300	375	445	500	290	350	395	300
350	420	505	570	330	395	445	350
400	455	545	615	355	425	480	400
500	515	620	700	405	485	545	500
600	575	690	780	455	545	615	600
700	630	755	850	500	595	670	700
750	655	785	885	515	620	700	750
800	680	815	920	535	645	725	800
900	730	870	980	580	700	790	900
1000	780	935	1055	625	750	845	1000
1250	890	1065	1200	710	855	965	1250
1500	980	1175	1325	795	950	1070	1500
1750	1070	1280	1445	875	1050	1185	1750
2000	1155	1385	1560	960	1150	1295	2000

Notes:

1. Section 310.15(B) shall be referenced for ampacity correction factors where the ambient temperature is other than 30°C (86°F).

2. Section 310.17 shall be referenced for conditions of use.

*Section 240.4(D) shall be referenced for conductor overcurrent protection limitations, except as modified elsewhere in the *Code*.

‡ ~~Applicable only to copper-clad aluminum.~~

Table 310.18 Ampacities of Insulated Conductors with Not More Than Three Current-Carrying Conductors in Raceway or Cable

Size AWG or kcmil	Temperature Rating of Conductor [See Table 310.4(1)]				Size AWG or kcmil
	150°C (302°F)	200°C (392°F)	250°C (482°F)	150°C (302°F)	
	Type Z	Types FEP, FEPB, PFA, SA	Types PFAH, TFE	Type Z	
	COPPER		NICKEL OR NICKEL-COATED COPPER	ALUMINUM OR COPPER-CLAD ALUMINUM	
14	34	36	39	—	14
12	43	45	54	30	12
10	55	60	73	44	10
8	76	83	93	57	8
6	96	110	117	75	6
4	120	125	148	94	4
3	143	152	166	109	3
2	160	171	191	124	2
1	186	197	215	145	1
1/0	215	229	244	169	1/0
2/0	251	260	273	198	2/0
3/0	288	297	308	227	3/0

Size AWG or kcmil	Temperature Rating of Conductor [See Table 310.4(1)]				Size AWG or kcmil
	150°C (302°F)	200°C (392°F)	250°C (482°F)	150°C (302°F)	
	Type Z	Types FEP, FEPB, PFA, SA	Types PFAH, TFE	Type Z	
	COPPER		NICKEL OR NICKEL-COATED COPPER	ALUMINUM OR COPPER-CLAD ALUMINUM	
4/0	332	346	361	260	4/0

Notes:

1. Section 310.15(B) shall be referenced for ampacity correction factors where the ambient temperature is other than 40°C (104°F).

2. Section 310.15(C)(1) shall be referenced for more than three current-carrying conductors.

3. Section 310.18 shall be referenced for conditions of use.

Table 310.19 Ampacities of Single-Insulated Conductors in Free Air

Size AWG or kcmil	Temperature Rating of Conductor [See Table 310.4(1)]				Size AWG or kcmil
	150°C (302°F)	200°C (392°F)	250°C (482°F)	150°C (302°F)	
	Type Z	Types FEP, FEPB, PFA, SA	Types PFAH, TFE	Type Z	
	COPPER		NICKEL, OR NICKEL-COATED COPPER	ALUMINUM OR COPPER-CLAD ALUMINUM	
14	46	54	59	—	14
12	60	68	78	47	12
10	80	90	107	63	10
8	106	124	142	83	8
6	155	165	205	112	6
4	190	220	278	148	4
3	214	252	327	170	3
2	255	293	381	198	2
1	293	344	440	228	1
1/0	339	399	532	263	1/0
2/0	390	467	591	305	2/0
3/0	451	546	708	351	3/0
4/0	529	629	830	411	4/0

Notes:

1. Section 310.15(B) shall be referenced for ampacity correction factors where the ambient temperature is other than 40°C (104°F).

2. Section 310.19 shall be referenced for conditions of use.

Table 310.20 Ampacities of Conductors on a Messenger

Size	Temperature Rating of Conductor [See Table 310.4(1)]	Size

AWG or kcmil	75°C (167°F)	90°C (194°F)	75°C (167°F)	90°C (194°F)	AWG or kcmil
	Types RHW, THHW, THW, THWN, XHHW, XHWN, ZW	Types MI, THHN, THHW, THW-2, THWN-2, RHH, RHW-2, USE-2, XHHW, XHHW-2, ~~XHWN,~~ XHWN-2, ZW-2	Types RHW, THW, THWN, THHW, XHHW, XHWN	Types THHN, THHW, RHH, XHHW, RHW-2, XHHW-2, THW-2, THWN-2, ~~XHWN,~~ XHWN-2, USE-2, ZW-2	
	COPPER		ALUMINUM OR COPPER-CLAD ALUMINUM		
8	57	66	44	51	8
6	76	89	59	69	6
4	101	117	78	91	4
3	118	138	92	107	3
2	135	158	106	123	2
1	158	185	123	144	1
1/0	183	214	143	167	1/0
2/0	212	247	165	193	2/0
3/0	245	287	192	224	3/0
4/0	287	335	224	262	4/0
250	320	374	251	292	250
300	359	419	282	328	300
350	397	464	312	364	350
400	430	503	339	395	400
500	496	580	392	458	500
600	553	647	440	514	600
700	610	714	488	570	700
750	638	747	512	598	750
800	660	773	532	622	800
900	704	826	572	669	900
1000	748	879	612	716	1000

Notes:

1. Section 310.15(B) shall be referenced for ampacity correction factors where the ambient temperature is other than 40°C (104°F).

2. Section 310.15(C)(1) shall be referenced for more than three current-carrying conductors.

3. Section 310.20 shall be referenced for conditions of use.

Table 310.21 Ampacities of Bare or Covered Conductors in Free Air

Copper Conductors				AAC Aluminum Conductors			
Bare		Covered		Bare		Covered	
AWG or kcmil	Amperes	AWG or kcmil	Amperes	AWG or kcmil	Amperes	AWG or kcmil	Amperes
8	98	8	103	8	76	8	80
6	124	6	130	6	96	6	101
4	155	4	163	4	121	4	127

Copper Conductors				AAC Aluminum Conductors			
Bare		Covered		Bare		Covered	
AWG or kcmil	Amperes	AWG or kcmil	Amperes	AWG or kcmil	Amperes	AWG or kcmil	Amperes
2	209	2	219	2	163	2	171
1/0	282	1/0	297	1/0	220	1/0	231
2/0	329	2/0	344	2/0	255	2/0	268
3/0	382	3/0	401	3/0	297	3/0	312
4/0	444	4/0	466	4/0	346	4/0	364
250	494	250	519	266.8	403	266.8	423
300	556	300	584	336.4	468	336.4	492
500	773	500	812	397.5	522	397.5	548
750	1000	750	1050	477.0	588	477.0	617
1000	1193	1000	1253	556.5	650	556.5	682
—	—	—	—	636.0	709	636.0	744
—	—	—	—	795.0	819	795.0	860
—	—	—	—	954.0	920	—	—
—	—	—	—	1033.5	968	1033.5	1017
—	—	—	—	1272	1103	1272	1201
—	—	—	—	1590	1267	1590	1381
—	—	—	—	2000	1454	2000	1527

Note: Section 310.21 shall be referenced for conditions of use.

Supplemental Information

File Name	Description	Approved
NEC_CMP6_310.21_SR8287.docx	For staff use	

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 25 14:39:23 EDT 2021

Committee Statement

Committee Statement: XHWN was deleted in the 90C columns in Tables 310.16, 310.17 and 310.20 because this insulation type is not rated for use at 90C.

Response Message: SR-8287-NFPA 70-2021

Public Comment No. 767-NFPA 70-2021 [Section No. 310.21]

Second Revision No. 8260-NFPA 70-2021 [Section No. 315.1]

315.1 Scope.

This article covers the use, installation, construction specifications, and ampacities for Type MV medium voltage conductors, cable, cable joints, and cable terminations. This article includes voltages from 2001 volts to 35,000 volts. This article does not ~~cover cables used~~ include voltages above 2500 volts for dc circuits.

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 25 12:37:39 EDT 2021

Committee Statement

Committee Statement: The scope was edited to clarify the specific voltage ranges for the requirements in Article 315.

Response Message: SR-8260-NFPA 70-2021

Public Comment No. 812-NFPA 70-2021 [Global Input]

Second Revision No. 8306-NFPA 70-2021 [Section No. 320.23]

320.23 In Accessible Attics.

Type AC cables in accessible attics or roof spaces shall be installed as specified in 320.23(A) and (B).

(A) Cables Run Across the Top of ~~Joists~~ Framing Members .

Where run across the top of ~~joists~~ framing members , or across the face of rafters or studding within 2.1 m (7 ft) of the floor or ~~joists~~ equivalent horizontal surface , the cable shall be protected by guard strips that are at least as high as the cable. Where this space is not accessible by permanently installed stairs or ladders, protection shall only be required within 1.8 m (6 ft) of the nearest edge of the scuttle hole or attic entrance.

(B) Cable Installed Parallel to Framing Members.

Where the cable is installed parallel to the sides of rafters, studs, or ceiling or floor joists, neither guard strips nor running boards shall be required, and the installation shall also comply with 300.4(D).

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 25 15:51:48 EDT 2021

Committee Statement

Committee Statement: The reference to Joists was changed to framing members in the title and when run across the top to eliminate confusion joists for ceilings or floors. When run across the face- the reference to Joists was changed to equivalent horizontal surface to be more inclusive of any walking or crawling surface.

Response Message: SR-8306-NFPA 70-2021

Public Comment No. 1326-NFPA 70-2021 [Section No. 320.23(A)]

Second Revision No. 8296-NFPA 70-2021 [Section No. 322.56(B)]

(B) Taps.

Taps shall be made between any phase conductor and the grounded conductor or any other phase conductor by means of devices and fittings identified for the use. Tap devices shall be rated at not less than 15 amperes, or more than 300 volts to ground, and shall be ~~color-coded~~ marked in accordance with 322.120(C).

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 25 15:14:41 EDT 2021

Committee Statement

Committee Statement: The term “color-coded” was changed to “marked” to correlate with the terminology in 322.120.

Response Message: SR-8296-NFPA 70-2021

Public Comment No. 773-NFPA 70-2021 [Section No. 322.56(B)]

Second Revision No. 8436-NFPA 70-2021 [Section No. 330.104]

330.104 Conductors.

For ungrounded, grounded, and equipment grounding conductors, the minimum conductor sizes shall be ~~16~~ 14 AWG copper, ~~14 AWG~~ nickel, or nickel-coated copper, and 12 AWG aluminum or copper-clad aluminum~~, and 12 AWG aluminum~~ .

For control and signal conductors, minimum conductor sizes shall be 18 AWG copper, nickel, or nickel-coated copper, 14 AWG copper-clad aluminum, and 12 AWG aluminum.

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Tue Oct 26 15:46:36 EDT 2021

Committee Statement

Committee Statement: The panel acted to revert to 2020 code language for the minimum size of conductors for 310.3(A), Tables 310.16 and 310.17, and wiring methods in multiple articles, including Articles 320, 330, 334, 336, and 340. To ensure public safety, further time is needed to study 14 AWG copper-clad aluminum and 16 AWG copper as minimum conductor sizes.

All of the public comments submitted on this topic were considered by the panel. Multiple test reports were presented to the panel as substantiation for the public comments in the 2023 revision cycle covering 14 AWG copper-clad aluminum conductor heating at certain ampacity levels under insulation to replicate a real-world installation. The reports point to the need for a deeper understanding of the performance of 14 AWG copper-clad aluminum.

During the 2023 NEC revision cycle, the panel received reports and presentations from:

1) the Bimetallics Task Group (conducted at an Eaton facility)

2) the Copper Development Association (conducted at a Hampton Tedder facility)

3) the Southwire company (conducted at the DB Cofer laboratory)

4) the Cable Technologies Laboratory (conducted at their facility)

5) the Cerrowire company (conducted at the Marmon Innovation and Technology Center)

The Panel also considered reports from the 2020 NEC revision cycle, including the NSF International report.

After considering all the information and results presented in the reports, public inputs, and public comments, concerns were recognized about conductor overheating in common, everyday installations that need to be addressed prior to reducing the allowable branch circuit conductor size. Primarily, the evidence of excessive heat rise that occurs when wiring methods are installed in thermal insulation needs to be addressed. Voltage drop was also identified as a concern and needs to be addressed.

To determine the appropriate code requirements to ensure the installation of reduced branch circuit conductor sizes is both practical and safe, additional information is

required. The panel requests public input that includes the following information obtained from credible sources and qualified testing laboratories:

1) Testing of representative wiring methods with 14 AWG copper-clad aluminum and 16 AWG copper shall be performed. Representative wiring methods could include those with non-metallic jackets, metallic sheaths, and those in metallic and non-metallic raceway systems.

2) Each wiring method shall have three current-carrying conductors.

3) At a minimum, testing of 16 AWG copper and 14 AWG copper-clad aluminum in thermal insulation is required. To address questions that were raised about existing branch circuit conductor sizes and heat rise in thermal insulation, the panel is also requesting testing of:

a. 14 AWG copper and 12 AWG copper-clad aluminum

b. 12 AWG copper and 10 AWG copper-clad aluminum

4) Equivalent testing of aluminum conductors is also welcomed.

5) For each wiring method, testing shall be performed at the 60C, 75C, and 90C ampacity values as appropriate as indicated or proposed in Table 310.16. Each test shall continue for a minimum of 3 hours or until thermal stability is reached, unless the temperature exceeds 150C at which point the test will be terminated. Conductor temperature shall be no more than 2C above ambient when each test begins.

6) At a minimum, testing shall include one continuous 100-foot length of wiring between the supply and load connections. Thermal insulation R-values and types shall comply with International Residential Code (IRC) Table N1102.1.3 minimum values for climate zone 5. A minimum of 90% of the wiring method shall be placed inside the thermal insulation. Testing that provides comparisons of differing thermal insulation types and R-values is encouraged.

7) Testing shall include installations that are representative of both attic and wall locations.

8) Thermocouples shall be affixed in contact with the insulation of a current-carrying conductor inside the wiring method. For cable wiring methods the jacket or sheath shall be replaced/restored over the thermocouple.

9) Thermocouples shall not be placed on or next to framing members or any other building components other than thermal insulation and the conductor insulation. Thermocouples shall be placed no less than every 10 feet along the wire within the wiring method and temperature data values shall be recorded no less than every 30 seconds. Thermocouples shall be placed on the conductor insulation within one foot of the supply and load connections. Ambient temperature shall be recorded continuously.

10) Voltage and current at the supply and load connections shall be monitored and values shall be recorded at a minimum of every 30 seconds.

11) All conductors shall be tested under equivalent conditions.

The panel has also identified remediating actions that could be taken to prevent overheating in this type of installation, including installation restrictions, reduced ampacity values in the Article 310 tables, or ampacity adjustment requirements.

Response Message: SR-8436-NFPA 70-2021

Public Comment No. 2068-NFPA 70-2021 [Section No. 330.104]

Public Comment No. 2173-NFPA 70-2021 [Section No. 330.104]

Second Revision No. 8309-NFPA 70-2021 [Section No. 330.112(A)]

(A) 1000 Volts or Less.

Insulated control and signal conductors in sizes 18 AWG and 16 AWG shall be of a type listed in Table 402.3, with a maximum operating temperature not less than 90°C (194°F) and as permitted by ~~725.49~~ 724.49 . ~~Conductors larger than 16 AWG~~ Ungrounded, grounded, and equipment grounding conductors 16 AWG and larger shall be of a type listed in Table 310.4(1) or of a type identified for use in Type MC cable.

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 25 16:04:30 EDT 2021

Committee Statement

Committee Statement: Editorial changes were made to this section to correlate with the addition of 16awg copper as a conductor for general use wiring.

The reference to 725.49 is changed to 724.49 based on first draft changes to Article 725.

Response Message: SR-8309-NFPA 70-2021

Public Comment No. 306-NFPA 70-2021 [Section No. 330.112(A)]

Second Revision No. 8337-NFPA 70-2021 [Section No. 334.40(B)]

(B) Devices of Insulating Material.

Self-contained switches, self-contained receptacles, and listed nonmetallic-sheathed cable interconnector devices of insulating material that are listed for ~~the purpose~~ use without a box shall be permitted to be used without boxes in exposed ~~cable wiring and for wiring in existing and new buildings where the cable is concealed~~ or concealed installations . Openings in such devices shall form a close fit around the outer covering of the cable, and the device shall fully enclose the part of the cable from which any part of the covering has been removed. Where connections to conductors are by binding-screw terminals, there shall be available as many terminals as conductors.

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 25 17:33:45 EDT 2021

Committee Statement

Committee Statement: An editorial change was made to 334.40(B). This change provided clarity and distinction by removing unnecessary words and changing the term “listed for the purpose” to “listed for use without a box”.

Response Message: SR-8337-NFPA 70-2021

Public Comment No. 1329-NFPA 70-2021 [Section No. 334.40(B)]

Public Comment No. 787-NFPA 70-2021 [Section No. 334.40(B)]

Second Revision No. 8437-NFPA 70-2021 [Section No. 334.104]

334.104 Conductors.

For ungrounded, grounded, and equipment grounding conductors, the conductor sizes shall be ~~16~~ 14 AWG through 2 AWG copper~~,~~ and ~~14~~ 12 AWG through 2 AWG copper-clad aluminum~~,~~ or ~~12 AWG through 2 AWG~~ aluminum.

For control and signaling conductors, the minimum conductor sizes shall be 18 AWG copper~~,~~ and ~~14~~ 12 AWG copper-clad aluminum~~,~~ and ~~12 AWG~~ aluminum.

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Tue Oct 26 15:53:37 EDT 2021

Committee Statement

Committee Statement: The panel acted to revert to 2020 code language for the minimum size of conductors for 310.3(A), Tables 310.16 and 310.17, and wiring methods in multiple articles, including Articles 320, 330, 334, 336, and 340. To ensure public safety, further time is needed to study 14 AWG copper-clad aluminum and 16 AWG copper as minimum conductor sizes.

All of the public comments submitted on this topic were considered by the panel. Multiple test reports were presented to the panel as substantiation for the public comments in the 2023 revision cycle covering 14 AWG copper-clad aluminum conductor heating at certain ampacity levels under insulation to replicate a real-world installation. The reports point to the need for a deeper understanding of the performance of 14 AWG copper-clad aluminum.

During the 2023 NEC revision cycle, the panel received reports and presentations from:

1) the Bimetallics Task Group (conducted at an Eaton facility)

2) the Copper Development Association (conducted at a Hampton Tedder facility)

3) the Southwire company (conducted at the DB Cofer laboratory)

4) the Cable Technologies Laboratory (conducted at their facility)

5) the Cerrowire company (conducted at the Marmon Innovation and Technology Center)

The Panel also considered reports from the 2020 NEC revision cycle, including the NSF International report.

After considering all the information and results presented in the reports, public inputs, and public comments, concerns were recognized about conductor overheating in common, everyday installations that need to be addressed prior to reducing the allowable branch circuit conductor size. Primarily, the evidence of excessive heat rise that occurs when wiring methods are installed in thermal insulation needs to be addressed. Voltage drop was also identified as a concern and needs to be addressed.

To determine the appropriate code requirements to ensure the installation of reduced branch circuit conductor sizes is both practical and safe, additional information is

required. The panel requests public input that includes the following information obtained from credible sources and qualified testing laboratories:

1) Testing of representative wiring methods with 14 AWG copper-clad aluminum and 16 AWG copper shall be performed. Representative wiring methods could include those with non-metallic jackets, metallic sheaths, and those in metallic and non-metallic raceway systems.

2) Each wiring method shall have three current-carrying conductors.

3) At a minimum, testing of 16 AWG copper and 14 AWG copper-clad aluminum in thermal insulation is required. To address questions that were raised about existing branch circuit conductor sizes and heat rise in thermal insulation, the panel is also requesting testing of:

a. 14 AWG copper and 12 AWG copper-clad aluminum

b. 12 AWG copper and 10 AWG copper-clad aluminum

4) Equivalent testing of aluminum conductors is also welcomed.

5) For each wiring method, testing shall be performed at the 60C, 75C, and 90C ampacity values as appropriate as indicated or proposed in Table 310.16. Each test shall continue for a minimum of 3 hours or until thermal stability is reached, unless the temperature exceeds 150C at which point the test will be terminated. Conductor temperature shall be no more than 2C above ambient when each test begins.

6) At a minimum, testing shall include one continuous 100-foot length of wiring between the supply and load connections. Thermal insulation R-values and types shall comply with International Residential Code (IRC) Table N1102.1.3 minimum values for climate zone 5. A minimum of 90% of the wiring method shall be placed inside the thermal insulation. Testing that provides comparisons of differing thermal insulation types and R-values is encouraged.

7) Testing shall include installations that are representative of both attic and wall locations.

8) Thermocouples shall be affixed in contact with the insulation of a current-carrying conductor inside the wiring method. For cable wiring methods the jacket or sheath shall be replaced/restored over the thermocouple.

9) Thermocouples shall not be placed on or next to framing members or any other building components other than thermal insulation and the conductor insulation. Thermocouples shall be placed no less than every 10 feet along the wire within the wiring method and temperature data values shall be recorded no less than every 30 seconds. Thermocouples shall be placed on the conductor insulation within one foot of the supply and load connections. Ambient temperature shall be recorded continuously.

10) Voltage and current at the supply and load connections shall be monitored and values shall be recorded at a minimum of every 30 seconds.

11) All conductors shall be tested under equivalent conditions.

The panel has also identified remediating actions that could be taken to prevent overheating in this type of installation, including installation restrictions, reduced ampacity values in the Article 310 tables, or ampacity adjustment requirements.

Response Message: SR-8437-NFPA 70-2021

Public Comment No. 2176-NFPA 70-2021 [Section No. 334.104]

Public Comment No. 1939-NFPA 70-2021 [Section No. 334.104]

Second Revision No. 8443-NFPA 70-2021 [Section No. 336.104]

336.104 Conductors.

For ungrounded, grounded, and equipment grounding conductors, the conductor sizes shall be ~~16~~ 14 AWG through 1000 kcmil copper, ~~14 AWG through 1000 kcmil copper-clad aluminum,~~ nickel, or nickel-coated copper, ~~or~~ and 12 AWG through 1000 kcmil aluminum or copper-clad aluminum . Insulation types shall be one of the types listed in Table 310.4(1) or Table 310.4(2) that is suitable for branch circuit and feeder circuits or one that is identified for such use.

For control and signal conductors, the minimum conductor sizes shall be 18 AWG copper, nickel, or nickel-coated copper, 14 AWG copper-clad aluminum, and 12 AWG aluminum.

(A) Fire Alarm Systems.

Where used for fire alarm systems, conductors shall also be in accordance with 760.49.

(B) Thermocouple Circuits.

Conductors in Type TC cable used for thermocouple circuits in accordance with Part III of Article ~~725~~ 724 shall also be permitted to be any of the materials used for thermocouple extension wire.

(C) Class 1 Circuit Conductors.

Insulated conductors of 18 AWG and 16 AWG copper shall also be in accordance with ~~725.49~~ 724.49 .

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Tue Oct 26 16:02:09 EDT 2021

Committee Statement

Committee Statement: The panel acted to revert to 2020 code language for the minimum size of conductors for 310.3(A), Tables 310.16 and 310.17, and wiring methods in multiple articles, including Articles 320, 330, 334, 336, and 340. To ensure public safety, further time is needed to study 14 AWG copper-clad aluminum and 16 AWG copper as minimum conductor sizes.

All of the public comments submitted on this topic were considered by the panel. Multiple test reports were presented to the panel as substantiation for the public comments in the 2023 revision cycle covering 14 AWG copper-clad aluminum conductor heating at certain ampacity levels under insulation to replicate a real-world installation. The reports point to the need for a deeper understanding of the performance of 14 AWG copper-clad aluminum.

During the 2023 NEC revision cycle, the panel received reports and presentations from:

1) the Bimetallics Task Group (conducted at an Eaton facility)

2) the Copper Development Association (conducted at a Hampton Tedder facility)

3) the Southwire company (conducted at the DB Cofer laboratory)

4) the Cable Technologies Laboratory (conducted at their facility)

5) the Cerrowire company (conducted at the Marmon Innovation and Technology Center)

The Panel also considered reports from the 2020 NEC revision cycle, including the NSF International report.

After considering all the information and results presented in the reports, public inputs, and public comments, concerns were recognized about conductor overheating in common, everyday installations that need to be addressed prior to reducing the allowable branch circuit conductor size. Primarily, the evidence of excessive heat rise that occurs when wiring methods are installed in thermal insulation needs to be addressed. Voltage drop was also identified as a concern and needs to be addressed.

To determine the appropriate code requirements to ensure the installation of reduced branch circuit conductor sizes is both practical and safe, additional information is required. The panel requests public input that includes the following information obtained from credible sources and qualified testing laboratories:

1) Testing of representative wiring methods with 14 AWG copper-clad aluminum and 16 AWG copper shall be performed. Representative wiring methods could include those with non-metallic jackets, metallic sheaths, and those in metallic and non-metallic raceway systems.

2) Each wiring method shall have three current-carrying conductors.

3) At a minimum, testing of 16 AWG copper and 14 AWG copper-clad aluminum in thermal insulation is required. To address questions that were raised about existing branch circuit conductor sizes and heat rise in thermal insulation, the panel is also requesting testing of:

a. 14 AWG copper and 12 AWG copper-clad aluminum

b. 12 AWG copper and 10 AWG copper-clad aluminum

4) Equivalent testing of aluminum conductors is also welcomed.

5) For each wiring method, testing shall be performed at the 60C, 75C, and 90C ampacity values as appropriate as indicated or proposed in Table 310.16. Each test shall continue for a minimum of 3 hours or until thermal stability is reached, unless the temperature exceeds 150C at which point the test will be terminated. Conductor temperature shall be no more than 2C above ambient when each test begins.

6) At a minimum, testing shall include one continuous 100-foot length of wiring between the supply and load connections. Thermal insulation R-values and types shall comply with International Residential Code (IRC) Table N1102.1.3 minimum values for climate zone 5. A minimum of 90% of the wiring method shall be placed inside the thermal insulation. Testing that provides comparisons of differing thermal insulation types and R-values is encouraged.

7) Testing shall include installations that are representative of both attic and wall locations.

8) Thermocouples shall be affixed in contact with the insulation of a current-carrying conductor inside the wiring method. For cable wiring methods the jacket or sheath shall be replaced/restored over the thermocouple.

9) Thermocouples shall not be placed on or next to framing members or any other building components other than thermal insulation and the conductor insulation. Thermocouples shall be placed no less than every 10 feet along the wire within the wiring method and temperature data values shall be recorded no less than every 30 seconds. Thermocouples shall be placed on the conductor insulation within one foot of

the supply and load connections. Ambient temperature shall be recorded continuously.

10) Voltage and current at the supply and load connections shall be monitored and values shall be recorded at a minimum of every 30 seconds.

11) All conductors shall be tested under equivalent conditions.

The panel has also identified remediating actions that could be taken to prevent overheating in this type of installation, including installation restrictions, reduced ampacity values in the Article 310 tables, or ampacity adjustment requirements.

The references in parts B and C have been updated in correlation with CMP 3 action to create a new Article 724 on Class 1 circuits.

Response Message: SR-8443-NFPA 70-2021

Public Comment No. 2186-NFPA 70-2021 [Section No. 336.104 [Excluding any Sub-Sections]]

Public Comment No. 2073-NFPA 70-2021 [Section No. 336.104 [Excluding any Sub-Sections]]

Second Revision No. 8298-NFPA 70-2021 [Article 337]

Article 337 ~~Drilling Rig~~ Industrial Mobile Cable: Type ~~P~~ IM

Part I. General

337.1 Scope.

This article covers the use, installation, and construction specifications for up through 2000 volt ~~drilling rig~~ industrial mobile cable, Type ~~P~~ IM (armored and unarmored).

337.6 Listing Requirements.

Type ~~P~~ IM cables and associated fittings shall be listed.

Part II. Installation

337.10 Uses Permitted.

Type ~~P~~ IM cable shall be permitted to be used as follows :

(1) Under engineering supervision in industrial installations where conditions of maintenance and supervision ensure that only qualified persons monitor and service the system.

(2) In hazardous (classified) locations where specifically permitted by other articles in this *Code*.

337.12 Uses Not Permitted.

Type ~~P~~ IM cable shall not be installed or used for the following :

(1) Where it will be exposed to physical damage

(2) Where not specifically permitted by other articles in the *Code*

337.24 Bending Radius.

The minimum bending radii during installations and handling in service shall be adequate to prevent damage to the cable.

337.30 Securing and Supporting.

Type ~~P~~ IM cable shall be supported and secured by cable ties listed and identified for securement and support; straps, hangers, or similar fittings; or other approved means designed and installed so as not to damage the cable.

337.31 Single Conductors.

Where single-conductor cables are used, the installation shall comply with 300.20.

337.80 Ampacity.

The ampacity of Type ~~P~~ IM cable shall be determined in accordance with 310.14(A) or (B) for 14 AWG and larger conductors. For 18 AWG and 16 AWG conductors, the ampacities shall be determined in accordance with Table 402.5 or 310.14(B). When installed in cable tray, the ampacities shall be permitted to be determined in accordance with 392.80. The installation shall not exceed the temperature ratings of terminations and equipment.

Part III. Construction Specifications

337.104 Conductors.

Conductors shall be of tinned copper. Conductors shall employ flexible stranding. The minimum conductor size shall be 18 AWG.

337.108 Equipment Grounding Conductor.

An equipment grounding conductor complying with 250.122 shall be provided within multiconductor Type ~~P~~ IM cable.

337.112 Insulation.

Insulated conductors shall be a thermoset type identified for use in Type ~~P~~ IM cable. All conductors shall be suitable for wet locations. The minimum wall thickness shall be 0.76 mm (30 mils).

337.114 Shield.

Metallic shield(s) shall be permitted over a single conductor or groups of conductors.

337.115 Jacket.

Multiconductor cables shall have an overall nonmetallic jacket that is impervious to moisture, corrosion resistant, and sunlight resistant. When installed external to an enclosure or industrial machinery, single conductor cables shall have an overall nonmetallic jacket that is impervious to moisture, corrosion resistant, and sunlight resistant. Single conductor cables rated 2000 volts with conductor sizes equal to or larger than 4/0 AWG shall be permitted to use an increased insulation thickness in lieu of using a separate cable jacket. When the increased insulation thickness is used, the insulation material shall be sunlight resistant.

337.116 Armor.

Armor shall be permitted over the jacket. If provided, the armor or metallic covering shall be a braided basket weave type consisting of wire laid closely together, flat and parallel, and forming a basket weave that shall firmly grip the cable. The wire shall be commercial bronze, tinned copper, stainless steel, or aluminum. The armor shall not be used as a current-carrying conductor or as an equipment grounding conductor. A nonmetallic jacket that conforms to 337.115 shall be provided over the armor.

337.120 Marking.

Type ~~P~~ IM cable shall be marked in accordance with 310.8. When an armor is provided, the cable shall be marked accordingly.

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 25 15:17:02 EDT 2021

Committee Statement

Committee Statement: The Article title and cable type designation were changed to Industrial Mobile Cable and Type IM. The references within the article were changed to reflect the new designations.

This article is not focused on Marine applications, most of which are not under the Scope of the NEC. Although similar Type P cables are used for offshore drilling rigs, those applications are not under the Scope of the NEC. There are already cable designations for instrumentation, control, and power cable in other parts of the NEC, and none of these terms would provide clarity for the Code user. VFD cable is not defined in the NEC, and this is not a cable specifically designed for VFD applications. Robust Industrial cable could easily be confused with other existing types of cable like Tray Cable or Metal-Clad Cable.

The primary use for this cable and the purpose for its inclusion in the NEC was to recognize a suitable wiring method for Land Based Drilling Rigs, but the cable would not be limited to that application by the Uses Permitted and Uses Not Permitted.

Like many cable wiring methods, there are other locations where the cable will likely be

useful, but the title chosen is the most descriptive and useful for the Code user. Just like with Service-Entrance Cable, the title does not limit the use of the wiring method. Uses Permitted and Uses Not Permitted are the determining sections for permissible uses of any particular wiring method.

Response Message: SR-8298-NFPA 70-2021

Public Comment No. 784-NFPA 70-2021 [Article 337]

Public Comment No. 2136-NFPA 70-2021 [Article 337]

Second Revision No. 8310-NFPA 70-2021 [Section No. 340.10]

340.10 Uses Permitted.

Type UF cable shall be permitted as follows:

(1) For use underground, including direct burial in the earth.

(2) As single-conductor cables. Where installed as single-conductor cables, all conductors of the feeder or branch circuit, including the grounded conductor and equipment grounding conductor, if any, shall be installed in accordance with 300.3.

(3) For wiring in wet, dry, or corrosive locations.

(4) Installed as nonmetallic-sheathed cable. Where so installed, the installation and conductor requirements shall comply with Parts II and III of Article 334, except for 334.12(B) , and shall be of the multiconductor type.

(5) As single-conductor cables as the nonheating leads for heating cables as provided in 424.43.

(6) Supported by cable trays. Type UF cable supported by cable trays shall be of the multiconductor type.

Informational Note: See 310.14(A)(3) for temperature limitation of conductors.

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 25 16:11:18 EDT 2021

Committee Statement

Committee Statement: Language was added to provide clarity that when UF cable is installed as NM cable it does not have to meet the requirements of 334.12(B).

Response Message: SR-8310-NFPA 70-2021

Public Comment No. 937-NFPA 70-2021 [Section No. 340.10]

Second Revision No. 8446-NFPA 70-2021 [Section No. 340.104]

340.104 Conductors.

For ungrounded, grounded, and equipment grounding conductors, the conductor sizes shall be ~~16~~ 14 AWG through 4/0 AWG copper~~, or 14 AWG through 4/0 AWG copper-clad aluminum,~~ or 12 AWG through 4/0 AWG aluminum or copper-clad aluminum .

Supplemental Information

File Name	Description	Approved
NEC_CMP6_340.104_SR8446.docx	Staff use only.	

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Tue Oct 26 16:08:13 EDT 2021

Committee Statement

Committee Statement: The panel acted to revert to 2020 code language for the minimum size of conductors for 310.3(A), Tables 310.16 and 310.17, and wiring methods in multiple articles, including Articles 320, 330, 334, 336, and 340. To ensure public safety, further time is needed to study 14 AWG copper-clad aluminum and 16 AWG copper as minimum conductor sizes.

All of the public comments submitted on this topic were considered by the panel. Multiple test reports were presented to the panel as substantiation for the public comments in the 2023 revision cycle covering 14 AWG copper-clad aluminum conductor heating at certain ampacity levels under insulation to replicate a real-world installation. The reports point to the need for a deeper understanding of the performance of 14 AWG copper-clad aluminum.

During the 2023 NEC revision cycle, the panel received reports and presentations from:

1) the Bimetallics Task Group (conducted at an Eaton facility)

2) the Copper Development Association (conducted at a Hampton Tedder facility)

3) the Southwire company (conducted at the DB Cofer laboratory)

4) the Cable Technologies Laboratory (conducted at their facility)

5) the Cerrowire company (conducted at the Marmon Innovation and Technology Center)

The Panel also considered reports from the 2020 NEC revision cycle, including the NSF International report.

After considering all the information and results presented in the reports, public inputs, and public comments, concerns were recognized about conductor overheating in common, everyday installations that need to be addressed prior to reducing the allowable branch circuit conductor size. Primarily, the evidence of excessive heat rise that occurs when wiring methods are installed in thermal insulation needs to be addressed. Voltage drop was also identified as a concern and needs to be addressed.

To determine the appropriate code requirements to ensure the installation of reduced branch circuit conductor sizes is both practical and safe, additional information is required. The panel requests public input that includes the following information obtained from credible sources and qualified testing laboratories:

1) Testing of representative wiring methods with 14 AWG copper-clad aluminum and 16 AWG copper shall be performed. Representative wiring methods could include those with non-metallic jackets, metallic sheaths, and those in metallic and non-metallic raceway systems.

2) Each wiring method shall have three current-carrying conductors.

3) At a minimum, testing of 16 AWG copper and 14 AWG copper-clad aluminum in thermal insulation is required. To address questions that were raised about existing branch circuit conductor sizes and heat rise in thermal insulation, the panel is also requesting testing of:

a. 14 AWG copper and 12 AWG copper-clad aluminum

b. 12 AWG copper and 10 AWG copper-clad aluminum

4) Equivalent testing of aluminum conductors is also welcomed.

5) For each wiring method, testing shall be performed at the 60C, 75C, and 90C ampacity values as appropriate as indicated or proposed in Table 310.16. Each test shall continue for a minimum of 3 hours or until thermal stability is reached, unless the temperature exceeds 150C at which point the test will be terminated. Conductor temperature shall be no more than 2C above ambient when each test begins.

6) At a minimum, testing shall include one continuous 100-foot length of wiring between the supply and load connections. Thermal insulation R-values and types shall comply with International Residential Code (IRC) Table N1102.1.3 minimum values for climate zone 5. A minimum of 90% of the wiring method shall be placed inside the thermal insulation. Testing that provides comparisons of differing thermal insulation types and R-values is encouraged.

7) Testing shall include installations that are representative of both attic and wall locations.

8) Thermocouples shall be affixed in contact with the insulation of a current-carrying conductor inside the wiring method. For cable wiring methods the jacket or sheath shall be replaced/restored over the thermocouple.

9) Thermocouples shall not be placed on or next to framing members or any other building components other than thermal insulation and the conductor insulation. Thermocouples shall be placed no less than every 10 feet along the wire within the wiring method and temperature data values shall be recorded no less than every 30 seconds. Thermocouples shall be placed on the conductor insulation within one foot of the supply and load connections. Ambient temperature shall be recorded continuously.

10) Voltage and current at the supply and load connections shall be monitored and values shall be recorded at a minimum of every 30 seconds.

11) All conductors shall be tested under equivalent conditions.

The panel has also identified remediating actions that could be taken to prevent overheating in this type of installation, including installation restrictions, reduced ampacity values in the Article 310 tables, or ampacity adjustment requirements.

Response Message: SR-8446-NFPA 70-2021

Public Comment No. 1940-NFPA 70-2021 [Section No. 340.104]

Public Comment No. 2191-NFPA 70-2021 [Section No. 340.104]

Second Revision No. 8308-NFPA 70-2021 [Section No. 398.15(C)]

(C) Exposed to Physical Damage.

Conductors within 2.1 m (7 ft) from the floor shall be considered exposed to physical damage. Where open conductors cross ceiling joists and wall studs and are exposed to physical damage, they shall be protected by one of the following methods:

(1) Guard strips shall not be less than 25 mm (1 in.) nominal in thickness and at least as high as the insulating supports, placed on each side of and close to the wiring.

(2) A substantial running board at least 13 mm (½ in.) thick in back of the conductors with side protections. Running boards shall extend at least 25 mm (1 in.) outside the conductors, but not more than 50 mm (2 in.), and the protecting sides shall be at least 50 mm (2 in.) high and at least 25 mm (1 in.), nominal, in thickness.

(3) Boxing made in accordance with 398.15(C)(1) or (C)(2) and furnished with a cover kept at least 25 mm (1 in.) away from the conductors within. Where protecting vertical conductors on side walls, the boxing shall be closed at the top and the holes through which the conductors pass shall be bushed.

(4) Rigid metal conduit (RMC), intermediate metal conduit (IMC), rigid polyvinyl chloride conduit (PVC), reinforced thermosetting resin conduit (RTRC), ~~high density polyethylene conduit (HDPE),~~ or electrical metallic tubing (EMT). When installed in metal piping, the conductors shall be encased in continuous lengths of approved flexible tubing.

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 25 16:02:41 EDT 2021

Committee Statement

Committee Statement: HDPE was removed from line item (4) as a permitted means to provide physical protection for open wiring on insulators. This was done because 353.12 prohibits its use for exposed installations.

Response Message: SR-8308-NFPA 70-2021

Public Comment No. 5-NFPA 70-2021 [Section No. 398.15(C)]

Second Revision No. 8274-NFPA 70-2021 [Section No. 400.4]

400.4 Types.

Flexible cords and flexible cables shall conform to the description in Table 400.4. The use of flexible cords and flexible cables other than those in Table 400.4 shall require permission by the authority having jurisdiction.

Table 400.4 Flexible Cords and Flexible Cables

Trade Name	Type Letter	Voltage	AWG or kcmil	Number of Conductors	Insulation	AWG or kcmil	Nominal Insulation Thickness mm	Nominal Insulation Thickness mils	
Lamp cord	C	300 600	18–16 15–10	2 or more	Thermoset or thermoplastic	18–16 15–10	0.76 1.14	30 45	C
Elevator cable	E [1,2,3,4]	300 or 600	20–2	2 or more	Thermoset	20–16 15–12 12–10 8–2	0.51 0.76 1.14 1.52	20 30 45 60	C
						20–16 15–12 12–10 8–2	0.51 0.76 1.14 1.52	20 30 45 60	F r j
Elevator cable	EO [1,2,4]	300 or 600	20–2	2 or more	Thermoset	20–16 15–12 12–10 8–2	0.51 0.76 1.14 1.52	20 30 45 60	C
Elevator cable	ETP [2,4]	300 or 600							F
	ETT [2,4]	300 or 600							N
Electric vehicle cable	EV [5,6]	1000	18–500	2 or more plus equipment grounding conductor(s), plus optional hybrid data, signal	Thermoset with optional nylon	18–15	0.76 (0.51)	30 (20)	C
						14–10	1.14 (0.76)	45 (30)	

Trade Name	Type Letter	Voltage	AWG or kcmil	Number of Conductors	Insulation	AWG or kcmil	Nominal Insulation Thickness mm	Nominal Insulation Thickness mils
						8–2	1.52 (1.14)	60 (45)
				communica- tions, and optical fiber cables		1–4/0	2.03 (1.52)	80 (60)
						250–500	2.41 (1.90)	95 (75)
	EVJ [5,6]	300	18–12			18–12	0.76 (0.51)	30 (20)
	EVE [5,6]	1000	18–500	2 or more plus equipment grounding conductor(s), plus optional hybrid data, signal communica- tions, and optical fiber cables	Thermoplastic elastomer with optional nylon	18–15	0.76 (0.51)	30 (20)
						14–10	1.14 (0.76)	45 (30)
						8–2	1.52 (1.14)	60 (45)
						1–4/0	2.03 (1.52)	80 (60)
						250– 500	2.41 (1.90)	95 (75)
	EVJE [5,6]	300	18–12			18–12	0.76 (0.51)	30 (20)
	EVT [5,6]	1000	18–500	2 or more plus equipment grounding conductor(s), plus optional hybrid data, signal communica- tions, and optical fiber cables	Thermoplastic with optional nylon	18–15	0.76 (0.51)	30 (20)
						14–10	1.14 (0.76)	45 (30)
						8–2	1.52 (1.14)	60 (45)
						1–4/0	2.03 (1.52)	80 (60)
						250– 500	2.41 (1.90)	95 (75)
	EVJT [5,6]	300	18–12			18–12	0.76 (0.51)	30 (20)
Portable power cable	G	2000	12–500	2–6 plus equipment grounding conductor(s)	Thermoset	12–2 1–4/0 250–500	1.52 2.03 2.41	60 80 95

Trade Name	Type Letter	Voltage	AWG or kcmil	Number of Conductors	Insulation	AWG or kcmil	Nominal Insulation Thickness mm	Nominal Insulation Thickness mils	
	G-GC[7]	2000	12–500	3–6 plus equipment grounding conductors and 1 ground check conductor	Thermoset	12–2 1–4/0 250–500	1.52 2.03 2.41	60 80 95	
Heater cord	HPD	300	18–12	2, 3, or 4	Thermoset	18–16 15–12	0.38 0.76	15 30	N
Parallel heater cord	HPN[8]	300	18–12	2 or 3	Oil-resistant thermoset	18–16 15 14 12	1.14 1.52 2.41	45 60 95	N
Thermoset jacketed heater cords	HSJ	300	18–12	2, 3, or 4	Thermoset	18–16 15–12	0.76 1.14	30 45	N
	HSJW	300	18–12		Thermoset				
	HSJO	300	18–12		Oil-resistant thermoset				
	HSJOW[9]	300	18–12						
	HSJOO	300	18–12						
	HSJOOW[9]	300	18–12						
Non-integral parallel cords	NISP-1	300	20–18	2 or 3	Thermoset	20–18	0.38	15	
	NISP-2	300	18–16			18–16	0.76	30	
	NISPE-1[8]	300	20–18		Thermoplastic elastomer	20–18	0.38	15	
	NISPE-2[8]	300	18–16			18–16	0.76	30	N
	NISPT-1[8]	300	20–18		Thermoplastic	20–18	0.38	15	
	NISPT-2[8]	300	18–16			18–16	0.76	30	
Twisted portable cord	PD	300 600	18–16 14–10	2 or more	Thermoset or thermoplastic	18–16 15–10	0.76 1.14	30 45	C

Trade Name	Type Letter	Voltage	AWG or kcmil	Number of Conductors	Insulation	AWG or kcmil	Nominal Insulation Thickness mm	Nominal Insulation Thickness mils	
Portable power cable	PPE[7]	2000	12–500	1–6 plus optional equipment grounding conductor(s)	Thermoplastic elastomer	12–2 1–4/0 250–500	1.52 2.03 2.41	60 80 95	
Hard service cord	S[7]	600	18–2	2 or more	Thermoset	18–15 14–10 8–2	0.76 1.14 1.52	30 45 60	N
Flexible stage and lighting power cable	SC[7,10]	600	8–250	1 or more	Thermoset	8–2 1–4/0 250	1.52 2.03 2.41	60 80 95	
	SCE[7,10]	600			Thermoplastic elastomer				
	SCT[7,10]	600			Thermoplastic				
Hard service cord	SE[7]	600	18–2	2 or more	Thermoplastic elastomer	18–15 14–9 8–2	0.76 1.14 1.52	30 45 60	N
	SEW[7,9]	600							
	SEO[7]	600							
	SEOW[7,9]	600							
	SEOO[7]	600			Oil-resistant thermoplastic elastomer				
	SEOOW[7,9]	600							
Junior hard service cord	SJ	300	18–10	2–6	Thermoset	18–11 10	0.76 1.14	30 45	N
	SJE	300			Thermoplastic elastomer				

Trade Name	Type Letter	Voltage	AWG or kcmil	Number of Conductors	Insulation	AWG or kcmil	Nominal Insulation Thickness	
							mm	mils
	SJEW[9]	300						
	SJEO	300						
	SJEOW[9]	300						
	SJEOO	300			Oil-resistant thermoplastic elastomer			
	SJEOOW[9]	300						
	SJO	300			Thermoset			
	SJOW[9]	300						
	SJOO	300			Oil-resistant thermoset			
	SJOOW[9]	300						
	SJT	300			Thermoplastic			
	SJTW[9]	300						
	SJTO	300				18–12 10	0.76 1.14	30 45
	SJTOW[9]	300						
	SJTOO	300			Oil-resistant thermoplastic			

Trade Name	Type Letter	Voltage	AWG or kcmil	Number of Conductors	Insulation	AWG or kcmil	Nominal Insulation Thickness mm	Nominal Insulation Thickness mils	
	SJTOOW[9]	300							
Hard service cord	SO[7]	600	18–2	2 or more	Thermoset	18–15	0.76	30	N
	SOW[7,9]	600							
	SOO[7]	600			Oil-resistant thermoset	14–9 8–2	1.14 1.52	45 60	
	SOOW[7,9]	600							
All thermoset parallel cord	SP-1	300	20–18	2 or 3	Thermoset	20–18	0.76	30	N
	SP-2	300	18–16			18–16	1.14	45	
	SP-3	300	18–10			18–16 15–14 12 10	1.52 2.03 2.41 2.80	60 80 95 110	
All elastomer (thermo-plastic) parallel cord	SPE-1[8]	300	20-18	2 or 3	Thermoplastic elastomer	20–18	0.76	30	N
	SPE-2[8]	300	18–16			18–16	1.14	45	
	SPE-3[8]	300	18–10			18–16 15–14 12 10	1.52 2.03 2.41 2.80	60 80 95 110	

Trade Name	Type Letter	Voltage	AWG or kcmil	Number of Conductors	Insulation	AWG or kcmil	Nominal Insulation Thickness		
							mm	mils	
All thermoplastic parallel cord	SPT-1	300	20–18	2 or 3	Thermoplastic	20–18	0.76	30	N
	SPT-1W[9]	300		2					
	SPT-2	300	18–16	2 or 3		18–16	1.14	45	
	SPT-2W[9]	300		2					
	SPT-3	300	18–10	2 or 3		18–16 15–14 12 10	1.52 2.03 2.41 2.80	60 80 95 110	
Range, dryer cable	SRD	300	10–4	3 or 4	Thermoset	10–4	1.14	45	N
	SRDE	300	10–4	3 or 4	Thermoplastic elastomer				N
	SRDT	300	10–4	3 or 4	Thermoplastic				N
Hard service cord	ST[7]	600	18–2	2 or more	Thermoplastic	18–15 14–9 8–2	0.76 1.14 1.52	30 45 60	N
	STW[7,9]	600							
	STO[7]	600							
	STOW[7,9]	600							
	STOO[7]	600			Oil-resistant thermoplastic				

Trade Name	Type Letter	Voltage	AWG or kcmil	Number of Conductors	Insulation	AWG or kcmil	Nominal Insulation Thickness mm	Nominal Insulation Thickness mils	
	STOOW[7]	600							
Vacuum cleaner cord	SV	300	18–16	2 or 3	Thermoset	18–16	0.38	15	N
	SVE	300			Thermoplastic elastomer				
	SVEO	300							
	SVEOO	300			Oil-resistant thermoplastic elastomer				
	SVO	300			Thermoset				
	SVOO	300			Oil-resistant thermoset				
	SVT	300			Thermoplastic				
	SVTO	300			Thermoplastic				
	SVTOO	300			Oil-resistant thermoplastic				
Parallel tinsel cord	TPT[11]	300	27	2	Thermoplastic	27	0.76	30	N
Jacketed tinsel cord	TST[11]	300	27	2	Thermoplastic	27	0.38	15	N
Portable power cable	W[7]	2000	12–500 501–1000	1–6 1	Thermoset	12–2 1–4/0 250–500 501–1000	1.52 2.03 2.41 2.80	60 80 95 110	

Notes:

All types listed in Table 400.4 shall have individual conductors twisted together, except for Types HPN, SP-1, SP-2, SP-3, SPE-1, SPE-2, SPE-3, SPT-1, SPT-2, SPT-3, SPT-1W, SPT-2W, TPT, NISP-1, NISP-2, NISPT-1, NISPT-2, NISPE-1, NISPE-2, and three-conductor parallel versions of SRD, SRDE, and SRDT.

The individual conductors of all cords, except those of heat-resistant cords, shall have a thermoset or thermoplastic insulation, except that the equipment grounding conductor, where used, shall be in accordance with 400.23(B).

[1]Rubber-filled or varnished cambric tapes shall be permitted as a substitute for the inner braids.

[2]Elevator traveling cables for operating control and signal circuits shall contain nonmetallic fillers as necessary to maintain concentricity. Cables shall have steel supporting members as required for suspension by 620.41. In locations subject to excessive moisture or corrosive vapors or gases, supporting members of other materials shall be permitted. Where steel supporting members are used, they shall run straight through the center of the cable assembly and shall not be cabled with the copper strands of any conductor.

In addition to conductors used for control and signaling circuits, Types E, EO, ETP, and ETT elevator cables shall be permitted to incorporate in the construction one or ~~more 20 AWG~~ more of the following: optical fibers; 24 AWG or larger telephone conductor pairs, ~~one or more~~ coaxial cables, ~~one~~ or ~~more optical fibers, or one or more~~ communications cables. The ~~20 AWG~~ 24 AWG or larger conductor pairs shall be permitted to be covered with suitable shielding for telephone, audio, data transfer, or higher frequency communications circuits; the coaxial cables shall consist of a center conductor, insulation, and a shield for use in video or other radio frequency communications circuits. The optical fiber shall be suitably covered with flame-retardant thermoplastic. The insulation of the conductors shall be rubber or thermoplastic of a thickness not less than specified for the other conductors of the particular type of cable. Metallic shields shall have their own protective covering. Where used, these components shall be permitted to be incorporated in any layer of the cable assembly but shall not run straight through the center.

[3]Insulations and outer coverings that meet the requirements as flame retardant, limited smoke, and are so listed, shall be permitted to be marked for limited smoke after the *Code* type designation.

[4]Elevator cables in sizes 20 AWG through 14 AWG are rated 300 volts, and sizes 10 AWG through 2 AWG are rated 600 volts. 12 AWG is rated 300 volts with a 0.76 mm (30 mil) insulation thickness and 600 volts with a 1.14 mm (45 mil) insulation thickness.

[5]Conductor size for Types EV, EVJ, EVE, EVJE, EVT, and EVJT cables apply to nonpower-limited circuits only. Conductors of power-limited (data, signal, or communications) circuits may extend beyond the stated AWG size range. All conductors shall be insulated for the same cable voltage rating.

[6]Insulation thickness for Types EV, EVJ, EVEJE, EVT, and EVJT cables of nylon construction is indicated in parentheses.

[7]Types G, G-GC, S, SC, SCE, SCT, SE, SEO, SEOO, SEW, SEOW, SEOOW, SO, SOO, SOW, SOOW, ST, STO, STOO, STW, STOW, STOOW, PPE, and W shall be permitted for use on theater stages, in garages, and elsewhere where flexible cords are permitted by this *Code*.

[8]The third conductor in Type HPN shall be used as an equipment grounding conductor only. The insulation of the equipment grounding conductor for Types SPE-1, SPE-2, SPE-3, SPT-1, SPT-2, SPT-3, NISPT-1, NISPT-2, NISPE-1, and NISPE-2 shall be permitted to be thermoset polymer.

[9]Cords that comply with the requirements for outdoor cords and are so listed shall be permitted to be designated as weather and water resistant with the suffix “W” after the *Code* type designation. Cords with the “W” suffix are suitable for use in wet locations and are sunlight resistant.

[10]The required outer covering on some single-conductor cables may be integral with the insulation.

[11]Types TPT and TST shall be permitted in lengths not exceeding 2.5 m (8 ft) where attached directly, or by means of a special type of plug, to a portable appliance rated at 50 watts or less

and of such nature that extreme flexibility of the cord is essential.

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 25 13:37:28 EDT 2021

Committee Statement

Committee Statement: This change correlates with the second revision changes made in 620.12 by CMP-12.

The smaller gauge wires are necessary to accommodate the additional communication requirements added to industry standards and some building codes for use with enhanced emergency communication systems for people with hearing loss.

The AWG sizes were not changed in the table in order to avoid allowing smaller circuit conductors in applications other than communications.

Response Message: SR-8274-NFPA 70-2021

Public Comment No. 1838-NFPA 70-2021 [Section No. 400.4]

Public Comment No. 2110-NFPA 70-2021 [Section No. 400.4]

Public Comment No. 2167-NFPA 70-2021 [Section No. 400.4]

Second Revision No. 8483-NFPA 70-2021 [Annex E]

Informative Annex E Types of Construction

This informative annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

E.1

Table E.1 Fire Resistance Ratings for Type I Through Type V Construction (hr)

-	Type I		Type II			Type III		Type IV	Type V	
	442	332	222	111	000	211	200	2HH	111	000
Exterior Bearing Walls[a]										
Supporting more than one floor, columns, or other bearing walls	4	3	2	1	0[b]	2	2	2	1	0[b]
Supporting one floor only	4	3	2	1	0[b]	2	2	2	1	0[b]
Supporting a roof only	4	3	1	1	0[b]	2	2	2	1	0[b]
Interior Bearing Walls										
Supporting more than one floor, columns, or other bearing walls	4	3	2	1	0	1	0	2	1	0
Supporting one floor only	3	2	2	1	0	1	0	1	1	0
Supporting roofs only	3	2	1	1	0	1	0	1	1	0
Columns										
Supporting more than one floor, columns, or other bearing walls	4	3	2	1	0	1	0	H	1	0
Supporting one floor only	3	2	2	1	0	1	0	H	1	0
Supporting roofs only	3	2	1	1	0	1	0	H	1	0
Beams, Girders, Trusses, and Arches										
Supporting more than one floor, columns, or other bearing walls	4	3	2	1	0	1	0	H	1	0
Supporting one floor only	2	2	2	1	0	1	0	H	1	0
Supporting roofs only	2	2	1	1	0	1	0	H	1	0
Floor/Ceiling Assemblies	2	2	2	1	0	1	0	H	1	0
Roof/Ceiling Assemblies	2	1½	1	1	0	1	0	H	1	0
Interior Nonbearing Walls	0	0	0	0	0	0	0	0	0	0
Exterior Nonbearing Walls[c]	0[b]	0[b]	0[b]	0[b]	0[b]	0[b]	0[b]	0[b]	0[b]	0[b]

Source: Table 7.2.1.1 from *NFPA 5000, Building Construction and Safety Code*, ~~2018~~ 2021 edition.

H: Heavy timber members.

[a]See 7.3.2.1 in *NFPA 5000*.

[b]See Section 7.3 in *NFPA 5000*.

[c]See 7.2.3.2.12, 7.2.4.2.3, and 7.2.5.6.8 in *NFPA 5000*.

E.2

Table E.1 contains the fire resistance rating, in hours, for Types I through V construction. The five different types of construction can be summarized briefly as follows (see also Table E.2):

E.2.1

Type I is a fire-resistive construction type. All structural elements and most interior elements are required to be noncombustible. Interior, nonbearing partitions are permitted to be 1- or 2-hour rated. For nearly all occupancy types, Type I construction can be of unlimited height.

Type II construction has three categories: fire-resistive, one-hour rated, and nonrated. The number of stories permitted for multifamily dwellings varies from two for nonrated and four for one-hour rated to 12 for fire-resistive construction.

Type III construction has two categories: one-hour rated and nonrated. Both categories require the structural framework and exterior walls to be of noncombustible material. One-hour rated construction requires all interior partitions to be one-hour rated. Nonrated construction allows nonbearing interior partitions to be of nonrated construction. The maximum permitted number of stories for multifamily dwellings and other structures is two for nonrated and four for one-hour rated.

Type IV ~~is a single~~ construction ~~category that provides for heavy timber construction. Both the structural framework and the exterior walls are required to be noncombustible except that wood members of certain minimum sizes are allowed. This construction type is seldom used for multifamily dwellings but, if used, would be permitted to be four stories high.~~ includes traditional heavy timber construction and mass timber construction. In heavy timber construction, the structural framework and the exterior walls are required to be noncombustible except that wood members of certain minimum sizes are allowed. In mass timber construction, structural elements of cross-laminated timber (CLT) are permitted. Allowable building height for mass timber is much higher than for heavy timber.

Type V construction has two categories: one-hour rated and nonrated. One-hour rated construction requires a minimum of one-hour rated construction throughout the building. Nonrated construction allows nonrated interior partitions with certain restrictions. The maximum permitted number of stories for multifamily dwellings and other structures is two for nonrated and three for one-hour rated.

Table E.2 Maximum Number of Stories for Types V, IV, and III Construction

Construction Type	Maximum Number of Stories Permitted
V Nonrated	2
V Nonrated, Sprinklered	3
V One-Hour Rated	3
V One-Hour Rated, Sprinklered	4
IV Heavy Timber	4
IV Heavy Timber, Sprinklered	5
IV Mass Timber	12
III Nonrated	2
III Nonrated, Sprinklered	3
III One-Hour Rated	4
III One-Hour Rated, Sprinklered	5

E.3

In Table E.1 the system of designating types of construction also includes a specific breakdown of the types of construction through the use of arabic numbers. These arabic numbers follow the roman numeral notation where identifying a type of construction [for example, Type I(442), Type II(111), Type III(200)] and indicate the fire resistance rating requirements for certain structural elements as follows:

(1) First arabic number — exterior bearing walls

(2) Second arabic number — columns, beams, girders, trusses and arches, supporting bearing walls, columns, or loads from more than one floor

(3) Third arabic number — floor construction

E.3.1

Table E.3 provides a comparison of the types of construction for various model building codes. [***5000*:** A.7.2.1.1]

Table E.3 Cross-Reference of Building Construction Types

NFPA 5000	**I (442)**	**I (332)**	**II (222)**	**II (111)**	**II (000)**	**III (211)**	**III (200)**	**IV (2HH)**	**V (111)**	**V (000)**
UBC	—	I FR	II FR	II 1 hr	II N	III 1 hr	III N	IV HT	V 1 hr	V N
B/NBC	1A	1B	2A	2B	2C	3A	3B	4	5A	5B
SBC	I	II	—	IV 1 hr	IV UNP	V 1 hr	V UNP	III	VI 1 hr	VI UNP
IBC	—	IA	IB	IIA	IIB	IIIA	IIIB	IV*	VA	VB

*Mass timber in the IBC is Type IV A, IV B, and IV C

Source: Table A.7.2.1.1 from *NFPA 5000, Building Construction and Safety Code*, ~~2018~~ 2021 edition.

UBC: *Uniform Building Code*.

FR: Fire rated.

N: Nonsprinklered.

HT: Heavy timber.

B/NBC: *National Building Code*.

SBC: *Standard Building Code*.

UNP: Unprotected.

IBC: *International Building Code*.

Supplemental Information

File Name	Description	Approved
NEC_CMP_6_SR8483_Annex_E.docx	For staff use	

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Wed Oct 27 14:59:58 EDT 2021

Committee Statement

Committee Statement: Changes were required to address the addition of mass timber buildings to Type IV construction in the model building codes.

Response Message: SR-8483-NFPA 70-2021

Public Comment No. 924-NFPA 70-2021 [Annex E]